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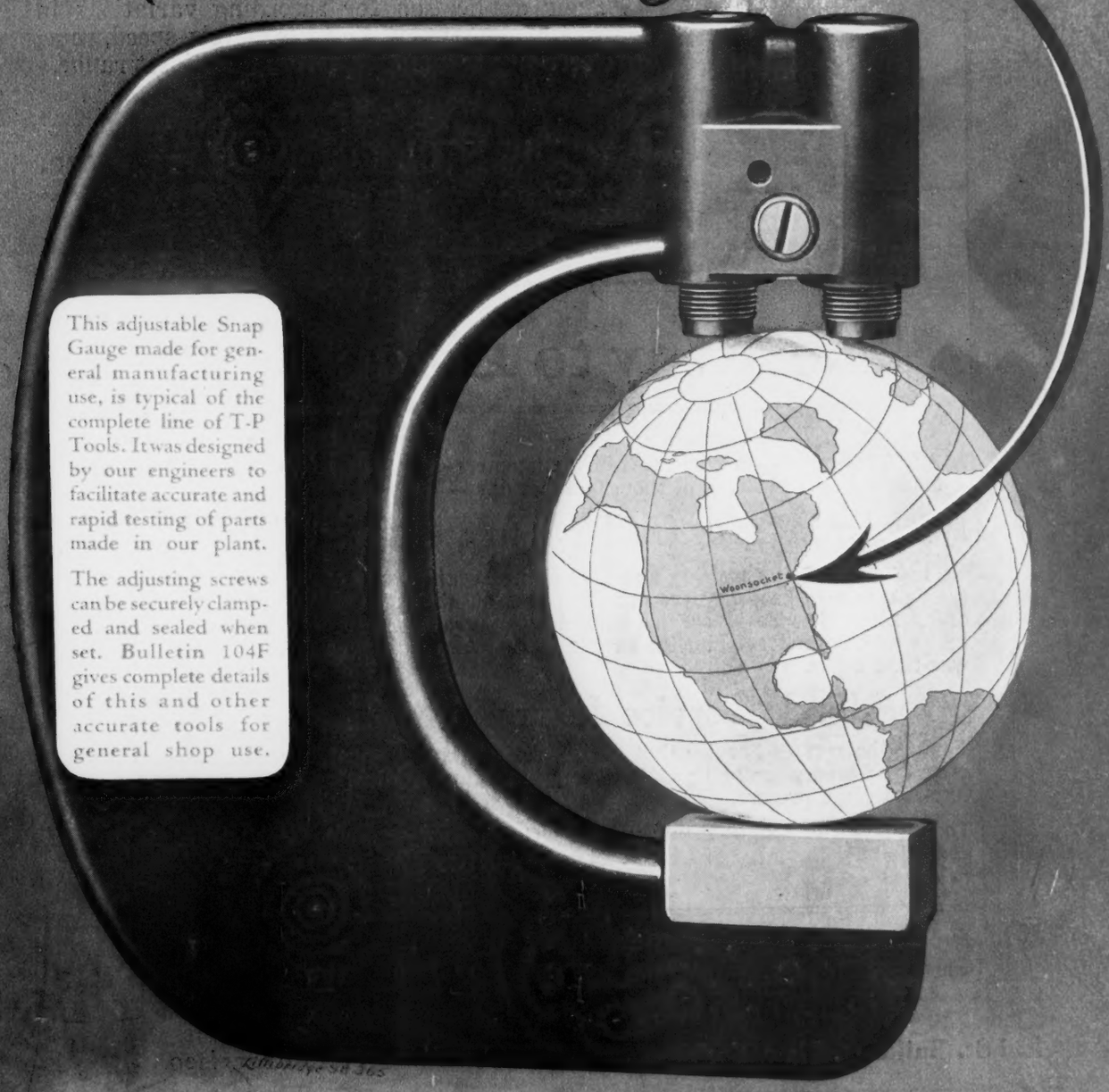

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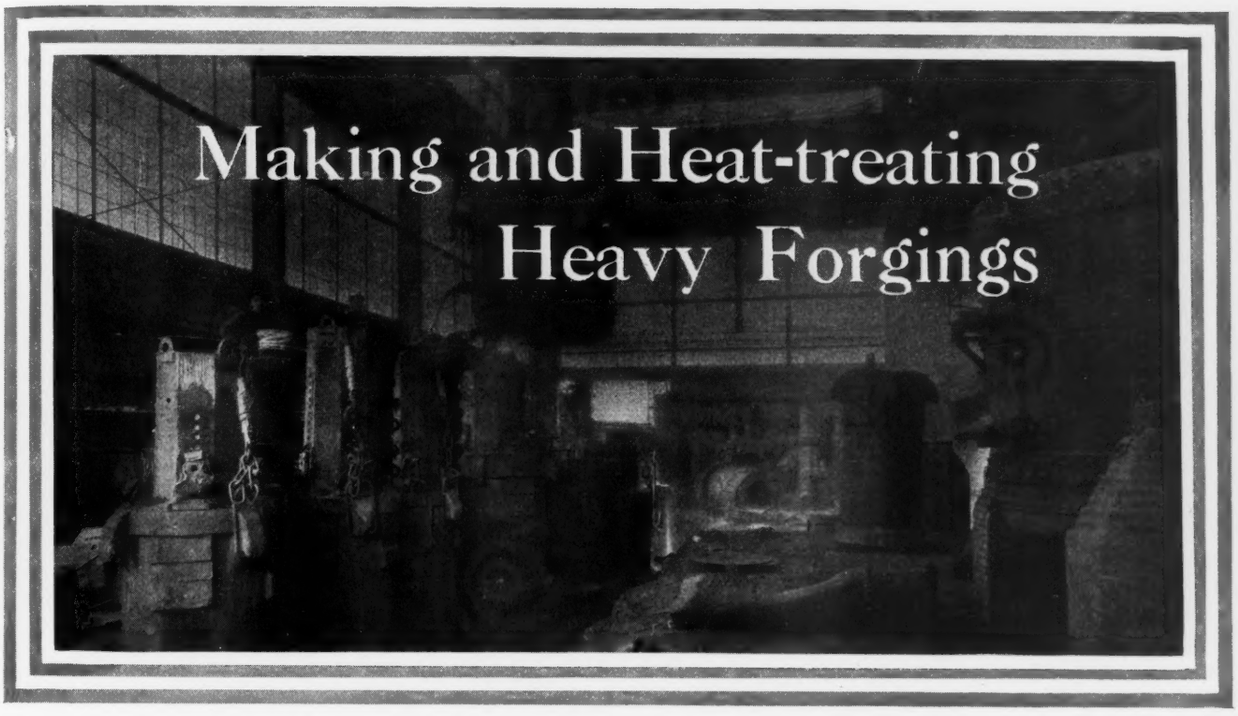
308-A

Making and Heat-treating Heavy Forgings



General Practice of the Tacony Ordnance Corporation in the Production of Ingots and Forgings for 155- and 240-Millimeter Guns

BY FRANKLIN D. JONES

IN a plant making large guns, the different processes employed—from the production of the steel and the forging of the ingot to the final operation in the machine shop—must conform to standards which are unusually high, because the work which the completed gun does is of such an intense nature and so much may depend upon it that the highest qualities in materials and workmanship are essential. The real work of gun making begins in the steel plant, and the quality of the finished product depends largely upon the metallurgist and steel maker in producing and reproducing steel having chemical and physical qualities which previous experience and tests have proved to be correct for whatever class of ordnance is under construction. The success of the Tacony Ordnance Corporation, Tacony, Philadelphia, Pa., in the manufacture of tubes, jackets, and hoops for heavy field guns and howitzers, is based primarily upon the attention which has been given to the steel making end of the work, although the mechanical processes for transforming the ingots into the proper shape conform to modern practice and are based on certain well established principles, so that the good qualities in the steel ingot are retained and the finished forgings have the required physical characteristics. The steel in the ingot, however, is of the greatest importance, and it must be of the right quality if the finished tube, jacket, or other part is to be satisfactory; if the steel is of poor quality this may be improved but not completely corrected by the other mechanical or heat-treating processes.

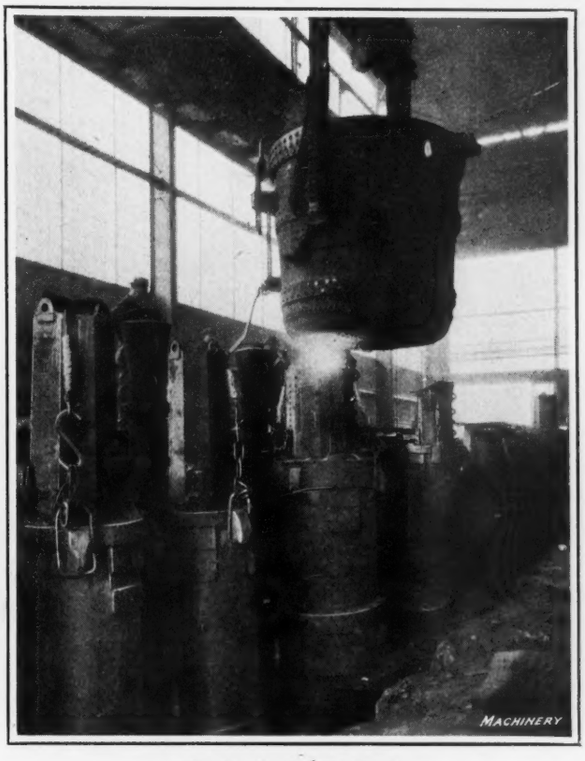


Fig. 1. Pouring the Ingots

At the Tacony Ordnance Corporation the work is chiefly on tubes, jackets, and hoops for the 155-millimeter field guns and the 240-millimeter howitzers for the United States Army. It might be well to explain that the tube is the inner part of a built-up gun, and forms the rifled bore as well as the seat for the projectile and the powder chamber. The jacket surrounds the rear or breech end of the tube and extends forward a distance equal to less than one-half the length of a gun. The jacket also extends far enough beyond the rear end of the tube to form a seat for the breech-block so that the extremely high pressures developed in the powder chamber are transmitted directly to the jacket instead of to the tube. The hoops surround the tube ahead of the jacket.

The production of these parts begins in the open-hearth furnace where the steel is made, and the processes that follow include forging the ingots, heat-treating, machining, and testing. The problems encountered in this work are made more complex, both from the metallurgical and mechanical viewpoints, because of the size of the ingots and the forgings required. These large ingots are more difficult to produce than smaller ones, and the different mechanical processes and appliances by means of which they are shaped to the required form involve the use of ponderous and powerful machinery as well as methods especially adapted to such heavy work.

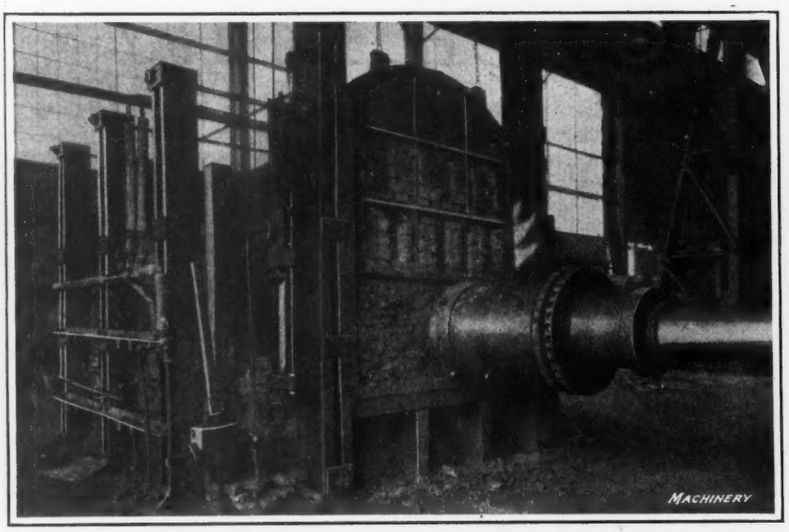


Fig. 2. One of the Oil-fired Furnaces in which Ingots are heated preparatory to forging

Kind of Steel Used

The open-hearth furnace is now used principally for making gun steel in preference to the original crucible process, which also applies to ordnance steel in general, although recently the electric furnace has been employed to some extent for this work. Plain carbon gun steel has a rather low carbon content of about 0.5 per cent or less. Alloy steels are used extensively at the present time for the various classes of ordnance work. The forgings referred to in this article are made of nickel steel containing approximately 3 per cent nickel, 0.40 per cent carbon, and 0.60 per cent manganese, with a phosphorus and sulphur content less than 0.05 per cent. This steel is made in an open-hearth furnace having an acid bottom, and the raw materials must be carefully selected to produce pure steel having the necessary mechanical and physical characteristics. The furnaces are of 40-ton capacity and are oil-fired. While much depends upon the operation of these furnaces, this part of the work will not be considered, since this article is to be confined to the more general features of the manufacturing practice.

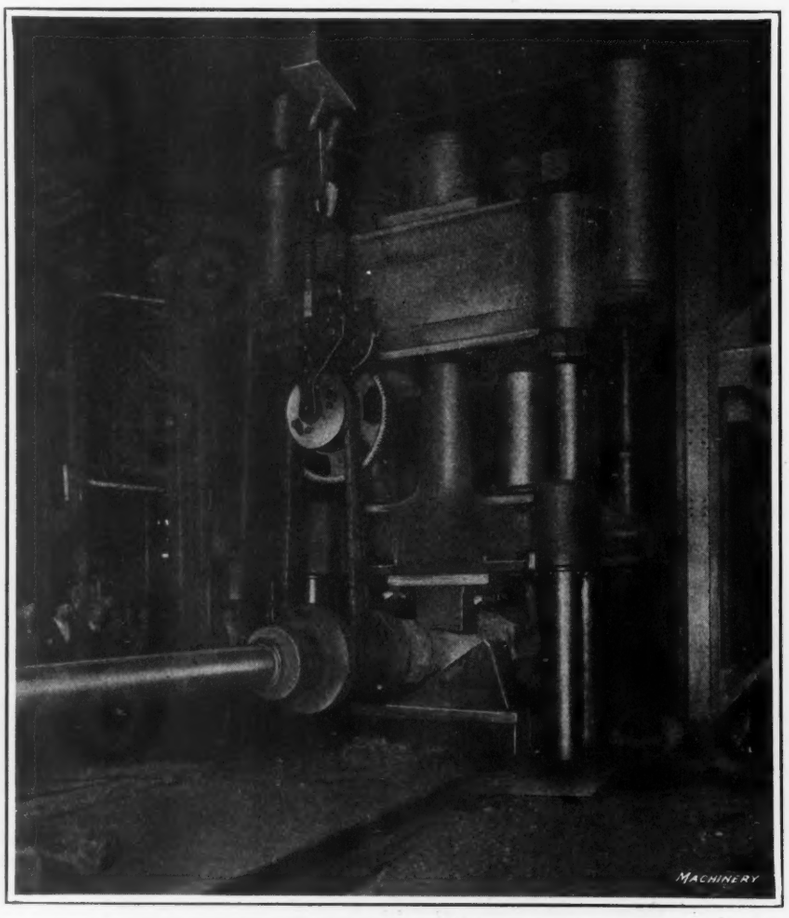


Fig. 3. Forging an Ingot under a 2000-ton Hydraulic Press

Pouring the Ingots

After steel of the right kind and quality has been produced in the open-hearth furnace, the next step in the manufacture of gun forgings is the casting of the ingots by pouring molten steel into a suitable mold. The exact method of pouring the ingots and the form of ingot mold used is considered a very important part of the work. The heading illustration shows a row of these ingot molds and illustrates the method of pouring. The large ladle, suspended above one of the molds by a crane, is first filled with molten steel from one of the open-hearth furnaces. This ladle holds forty tons of steel, and the pouring is done through a hole in the bottom of the ladle. The mold itself is formed of a heavy iron casting, and at one side there is a vertical runner which connects with the mold at the bottom and extends up above the highest part. On the top of the main body there is a relatively thin flask which forms an extension of the mold and is of smaller size. This flask and the vertical runner are lined with refractory brick, but the main body of the mold comes into direct contact with the molten steel.

When pouring an ingot, the metal is poured into the vertical runner and flows up into the main part of the mold through an opening in the bottom. As the runner is kept full of metal by the constant flow from the ladle, the level in the ingot mold gradually rises. When the main part of the mold has been filled, the ladle is moved over to the position shown in Fig. 1, and the hot metal is slowly poured directly into the top of the mold. The object of this shift in the pouring position is to prevent the formation of a cavity or "pipe" at the upper end of the ingot such as would occur if the top were not fed by this body

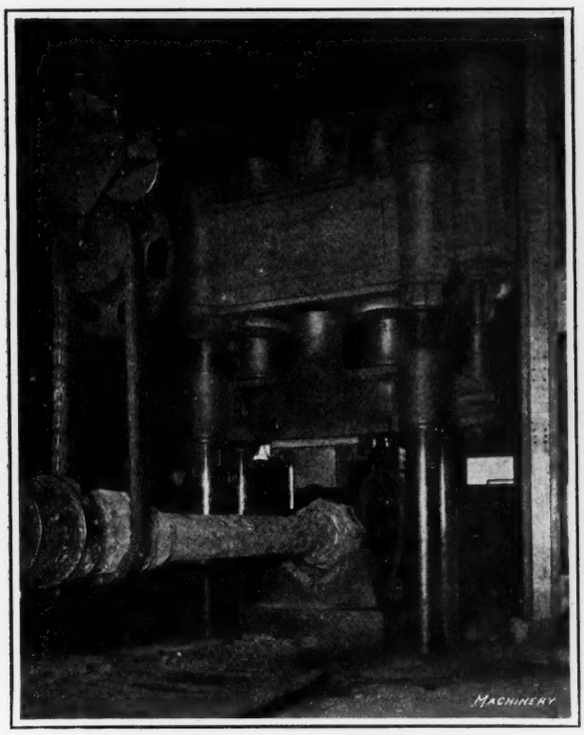


Fig. 4. Ingot after being partially drawn out to form Tube of 240-millimeter Howitzer

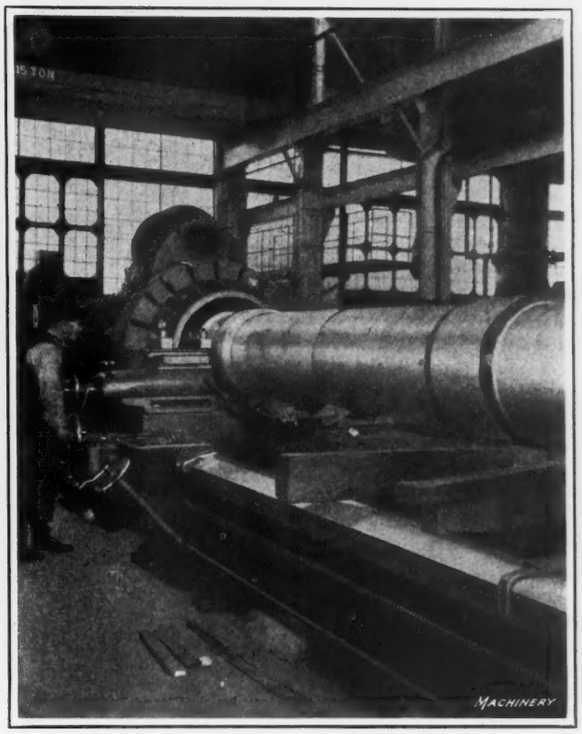


Fig. 5. Rough-turning Operation on Hoop Forgings for 240-millimeter Howitzer

of hot metal which is introduced after the ingot proper has been bottom-poured. As is well known, the formation of the pipe in the center of an ingot is due to the fact that the metal in contact with the mold first cools and solidifies, and the contraction which naturally follows causes the metal to be drawn away from the center of the ingot. After the ladle is shifted directly over the mold the pouring is done quite slowly at first so that the top of the ingot is supplied with hot metal directly from the ladle during the period in which a pipe might form. After this upper flask has been filled, thus forming the sink-head or tong-hold, a heavy steel eye is partly submerged into the molten metal and is held there until the metal has cooled enough to hold it in position. This eye provides a hold for the crane hook.

Why Ingots are Bottom-poured

While all metallurgists and steel makers do not agree that bottom-poured ingots possess the superior qualities which others claim for them, the principal advantages from this method of pouring are as follows: In the first place the metal flows up into the mold very quietly and without any splashing such as occurs when pouring from the top and especially when first beginning to pour into the bottom of the mold. This splashing action which accompanies top-pouring results in a poor surface condition of the ingot. It is also claimed that when pouring from the bottom there is less tendency to entrap dirt or foreign matter in the ingot, as this is carried outward to the surface of the mold when the metal flows up through the opening in the center. Still another advantage claimed for the bottom method of pouring is that there is practically no oxidizing action of the air upon the stream of metal which flows from the ladle. The distance between the bottom of the ladle and the top of the runner is only a few inches, so that there is no time for oxidizing action to occur, which is not the case when the metal is poured from the top and there is a long stream extending from the ladle to the level of the metal in the ingot. Some metallurgists contend that the advantages which might accrue from bottom-pouring are partially, if not entirely, offset by a slagging off of the refractory lining in the runner. While this would be injurious, the contention is that such slagging action can be reduced until it is negligible.

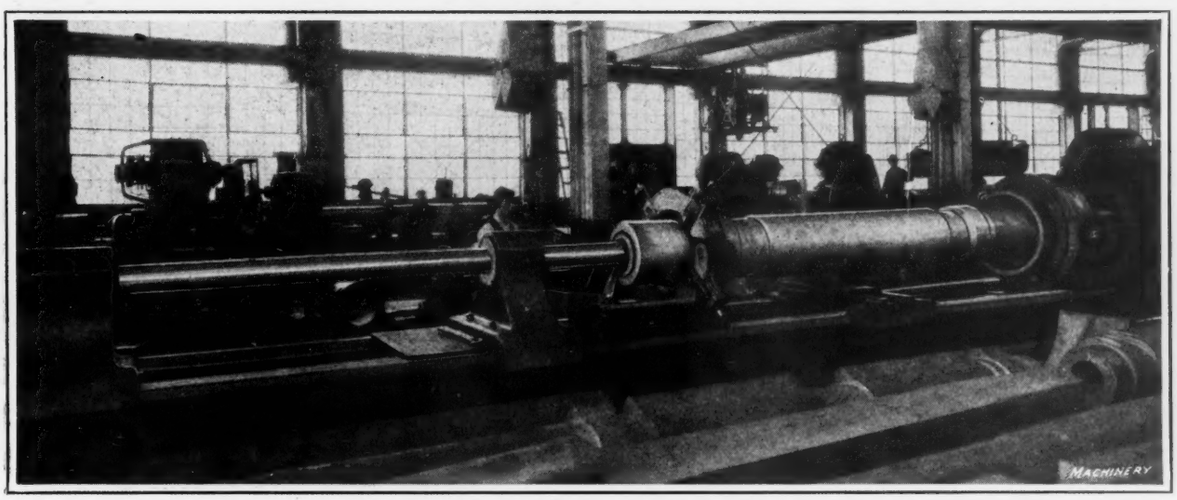


Fig. 6. Boring a Hole through the Center of a Large Hoop Forging

Shape of the Ingots and Area as Compared with Forgings

These ingots are not round, but practically of octagonal form, although the eight sides are concave or fluted instead of being flat. Here is another feature concerning which opinions differ, the ingots in some other plants preferably being made with flat sides. The reason for the fluted form is to avoid the checks or cracks in the ingots at the corners. By making the sides concave the practical effect is to add metal at the corners, and reinforce them against the severe shrinkage strains set up as the outside of the ingot cools and solidifies while the interior is still molten or in a soft plastic state.

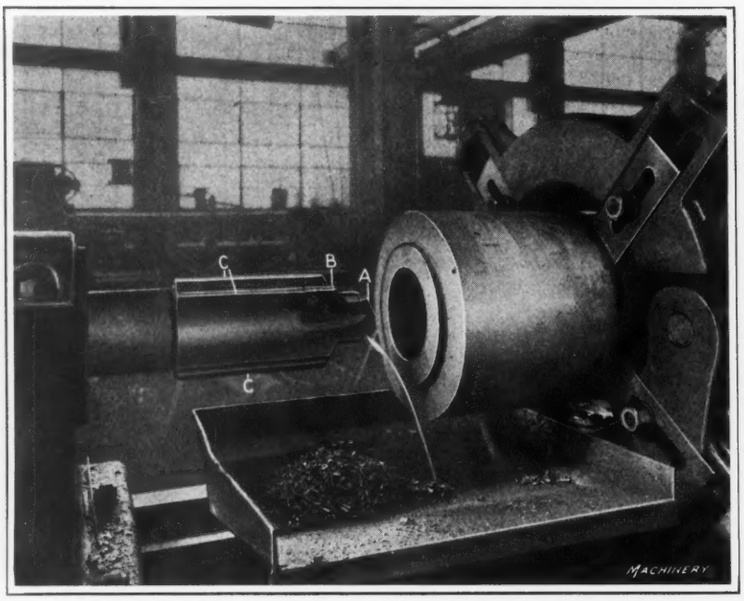


Fig. 7. Detail View of Cutter-head which bores a 9-inch Hole from the Solid

The size of the ingot or the area of its cross-section must be about twice the area of the finished forging, though formerly a larger ratio was required. Since the difficulty of making a perfect ingot increases with the size, it is believed that the ratio of the ingot area to the forging area should not be too large. Moreover, the less an ingot is elongated in forging, the better will be the physical tests on pieces cut transversely from the forging; and since transverse tests are required in the case of gun forgings, this is another reason why the area of the ingot should not be too large in proportion to the area of the finished forging. In casting these ingots, an allowance is always made for cropping a certain amount from the ends. The sink-head or tong-hold previously referred to, is entirely removed and also a part of the ingot body.

Heating the Ingot for Forging

The ingot, after being poured, is allowed to stand for about six hours, or until it cools down to a temperature of 800 or 900 degrees F. It is then taken to the forging department and placed in a furnace, where it is heated preparatory to the forging operation. There are a number of these furnaces in the forging department. Some of them are designed to hold a single ingot, and others are of duplex form, two ingots being heated simultaneously. A furnace of the single type is shown in Fig. 2. The ingot is in a horizontal position, and the tong-hold projects outside. In this particular illustration, a large sleeve or chuck has been placed over the tong-hold, and extending beyond this sleeve there is a heavy bar known as the "porter bar," which serves to counterbalance the weight of the ingot when suspended from the crane. The chuck is secured to the tong-hold by large set-screws which may be seen in the illustration. The chuck and porter bar have been attached to this particular ingot because it is nearly ready for forging. This is an oil-fired furnace, and it has a vertical sliding door in front which is operated by a hydraulic hoisting device. The space around the ingot being heated between the bottom of the door and the floor of the furnace is filled with bricks and fireclay.

It is essential to heat the ingots uniformly and avoid heating the outer section faster than the metal at the interior, because the ingots have internal strains due to the cooling in the mold, and cracks may develop if there is unequal expansion caused by a lack of uniform heating in the forging department. The ingots should be heated to a temperature of about 2100 degrees F. and they should be allowed to remain in the furnace or "soak" until the temperature is uniform throughout. The time required depends upon the size of the ingot and may be from twenty to thirty hours or more.

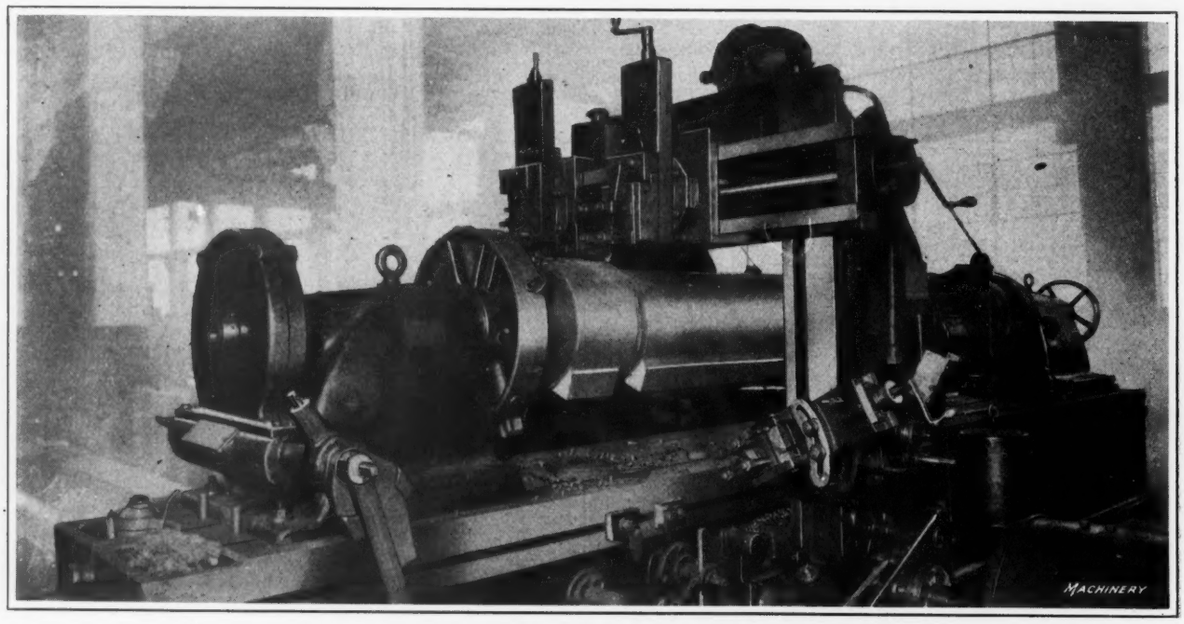


Fig. 8. Planer arranged for machining Cylindrical Surfaces which cannot be turned because of Interference between Turning Tool and Slides on Sides of Forging

Forging the Ingot

As a general rule, the ingot is completely forged in one heat; in fact, when an ingot must be heated a second time this is considered undesirable forging practice, and it is seldom necessary unless there is a breakdown or some other unexpected difficulty. Fig. 3 shows a 2000-ton hydraulic press forging a tube for a 240-millimeter howitzer. This view shows the first stage of the forging process, and was taken soon after the ingot was placed under the press. One of the interesting features of this work is the method of handling the huge ingot and of directing the forging operation. The ingot with its attached chuck and porter bar is supported principally from an overhead traveling crane from which is suspended an electrically operated mechanism for turning the forging or rolling it over in order to bring different sides into the forging position. This turning mechanism consists chiefly of a motor which drives through worm and spur gearing an upper drum, from which is suspended a heavy chain belt that passes around the chuck attached to the ingot. As the motor and its gear-driven drum are revolved, a rotary movement is also transmitted to the forging. During the first stages of the work the opposite end of the ingot is also supported by a sling suspended from a hoist, as it is necessary to lift the ingot far enough to clear the anvil each time it is to be turned to a different position. Later, when the ingot has been reduced and is approximately round, the extra hoist at the far end is not needed as the forging can be turned easily in the V-shaped anvil.

The forging process is controlled by one man who indicates by movements of the hand whether the forging is to be turned, elevated, or shifted. One man, by means of a lever at the side of the press, controls the movements of the press head, another controls the turning mechanism, and a third man controls the end hoist previously mentioned. In addition, the crane operator regulates the height of the forging and its position in a lengthwise direction. These various operators are guided entirely by the signals of the forger, who is expert in controlling the forging process by this method.

Fig. 4 shows the partly completed forging. The far end of the ingot, which up to this time has been suspended from the hoist on the opposite side of the press, has just been placed on the anvil to be reduced to the proper diameter. The time required for drawing out a tube of this size is about one hour, and as previously mentioned, it does not need to be reheated because such a large mass of metal retains the necessary forging heat. While the steam hammer is sometimes used for drawing out heavy gun forgings, the hydraulic press is generally preferred for work of this kind, especially when large ingots must be forged. The hydraulic press applies a gradual pressure, as compared with the sudden blow of a hammer, and consequently the metal has more time to flow, and a more uniform density is obtained. Another advantage is that the forging pressure, in the case of a hydraulic press, is taken by the large columns or tie-rods connecting the anvil or lower part with the head. For this reason a large foundation is not required, as in the case of a steam hammer adapted to such heavy work.

After the forging has been reduced to the right size and is drawn out to the required length, the ends are cropped or cut off. The entire sink-head or tong-hold is removed and also a short section of the top end of the ingot body. This cropping is usually done under the hydraulic press, the forging being pushed down upon a knife or wedge upon the anvil. The forging is first cut half way through on one side, and then it is turned over and the remaining half severed. Sometimes the forging becomes too cold for cropping by this method, and then an oxy-hydrogen torch is used after the forging is finished.

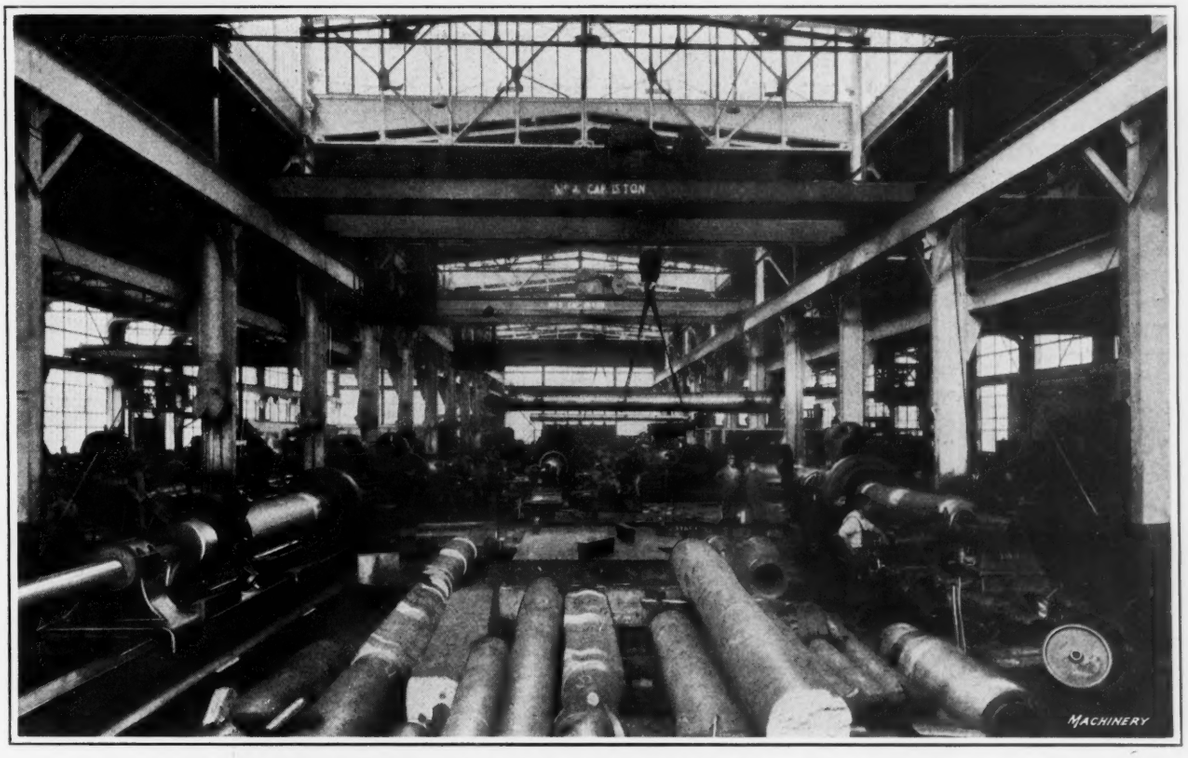


Fig. 9. General View of the Machine Shop at the Plant of the Tacony Ordnance Corporation

Annealing the Forgings

After the heavy ingot, which is 3 feet or more in diameter, has been gradually reduced and drawn out to form a long forging, the working of the metal causes internal strains, which must be relieved by annealing. This annealing is done by heating the forging to a temperature considerably above the critical range, this temperature being maintained long enough to insure uniform heating, and a uniform condition. The exact procedure from this point on may depend somewhat upon the size of the forging, the composition of the steel, and the physical results desired. In many cases the forging is heated to a temperature of about 1600 degrees F., which is well above the critical range, and then it is cooled rather quickly in the air until it has reached a tem-

perature of about 900 degrees. The temperature is then raised again to about 1400 degrees, and after the forging has soaked for a long enough period to insure a uniform temperature throughout the section, the furnace is allowed to cool slowly.

The type of furnace used for this work is sometimes known as a "bung-top" furnace. It is of a horizontal, rectangular form having removable sections or lids on the top which are lifted off when charging the furnace or removing the annealed forgings. The temperatures in this furnace at various stages of the annealing process are indicated by recording pyrometers and a number of thermo-couples which are inserted in the furnace at different points.

Rough-machining Operations on Tubes, Jackets, and Hoops

The rough-machining of the different parts such as tubes, jackets, and hoops consists principally in boring a hole through the center of the forging and machining the outside by turning, and in some cases by the use of other tools in conjunction with the lathe. The forging is first given a preliminary turning, which provides true surfaces for steadyrest bearings, and also, by removing the outer layer of metal, shows any seams or other defects that may have developed. Fig. 5 shows one of the hoop forgings in the lathe. This forging is for a 240-millimeter howitzer, and it forms two A-hoops, as they are called, the forging being parted in the center later on.

A similar hoop forging is shown in the gun boring lathe in Fig. 6. All of these forgings are bored from the solid, instead of forging them hollow as is the practice in some plants where large guns are constructed. The boring is done from one end only, the cutter-head passing completely through the center of the forging. The type of cutter-head used is shown in detail in Fig. 7. It is equipped with a flat high-speed steel cutter *A*, which is ground and pointed practically the same as a flat drill. Just back of this cutter there are other flat cutters *B* on each side, which enlarge the bore formed by the leading cutter. The edges of these cutters are notched at intervals in order to break up the chips and prevent them from clogging in the bore. A pipe for supplying cutting compound passes through the long bar which supports the cutter-head and connects with the latter at the rear. The cutting compound flows forward to the cutting end through two holes located on each side of the leading cutter. The location of one of these holes is indicated by the stream of cutting compound seen flowing out of one of them in Fig. 7. After this cutter-head has entered the bore it is steadied by guide plates or strips *C*, which prevent it from being deflected laterally. By means of this cutter-head the hole is bored to a diameter of 9 inches in one passage of the tool, the feeding movement being at the rate of about 24 inches per hour. This 9-inch hole is next enlarged to 14¼ inches, in this particular case, by a cutter-head which is similar in design to the one just described. The long boring-bar is supported near the end of the work by a bearing through which it slides. The rear end of the bar is clamped to the heavy tailstock seen at the left in Fig. 6, which connects with the lead-screw in the center of the bed from which the feeding movement is derived.

Fig. 8 illustrates how planers are used for machining the cylindrical surfaces of hoops for the 155-millimeter guns. The hoops are provided with slides which make it impossible to turn these surfaces in the lathe because of the interference between the turning tool and the slides on each side. The forging is supported by a center at one end and by a chuck at the other so that it can be given a circular feeding movement for planing the surface between the slides. This circular motion is derived from a mechanism forming part of the headstock carrying the chuck. The spindle upon which the chuck is mounted has a worm-wheel at the opposite end meshing with a worm which may be turned by means of the lever seen at the end of the worm-shaft. As this lever moves to and fro with the planer table, it encounters stops at each end of the travel which give it a swinging movement, thus transmitting a circular feeding movement to the work through the gearing referred to. The adjustable stops are attached to a bar bolted to the base of the planer, and the feeding lever operates through a ratchet mechanism so that one stop controls the feeding movement and the other one returns the lever. As the various parts which go to make up the gun are not assembled in this plant, they are only rough-machined. A general view of the machine shop is shown in Fig. 9.

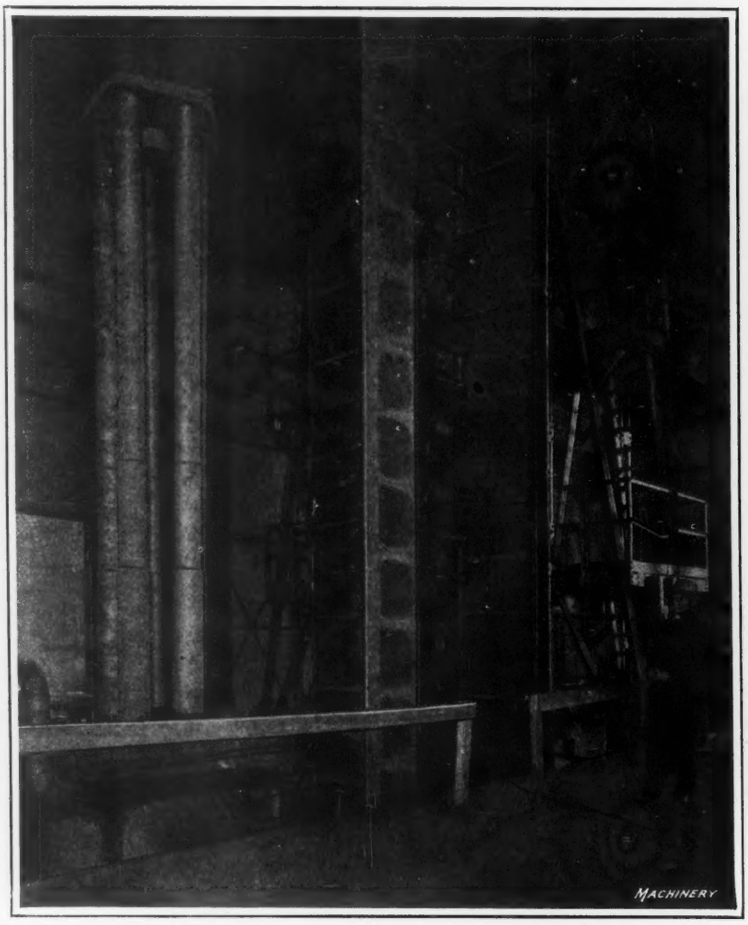


Fig. 10. Vertical Side-door Type of Furnace for heating Long Forgings such as the Tubes shown in the Illustration

Hardening the Forgings after Rough-machining

The heat-treatment which follows the rough-machining operations is a two-stage process. First the forgings are hardened, and then drawn or tempered. While the annealing which follows the forging relieves the strains and refines the grain, it also reduces the tensile strength and elastic limit of the steel, and additional heat-treatment is necessary to increase the strength. The hardening is done by heating the forgings to a temperature above the critical range and then plunging them into hot water. Vertical furnaces are used for heating the forgings preparatory to hardening. The type of vertical furnace used for parts such as long tubes is illustrated in Fig. 10. This furnace is about 40 feet high, and it has a door at the side extending

from the top to the bottom. The furnaces used for shorter work are charged through an opening at the top, which is provided with suitable doors. The open-top furnace is preferable for the shorter forgings, to the side-door type, but the latter is more practicable for long forgings in order to reduce the amount of head room required, and also to facilitate charging and removing the work. The long vertical side door is objectionable on account of warpage and the difficulty of keeping it tight.

The illustration Fig. 10 shows the side door open and five 155-millimeter tubes about to be lowered into the quenching tank which is a few feet beneath them. This huge door is operated by means of an electric motor and a train of gearing connecting with a segment gear attached to the lower end of the door. The forgings are suspended from a heavy casting, as the illustration shows, and when in the furnace they are supported by I-beams which are hinged at one end and swing in beneath this casting. The furnace has an inner and outer wall, and it is oil-fired at the bottom. The flame and hot gases pass up between the two walls and into the furnace through openings in the inner wall. These

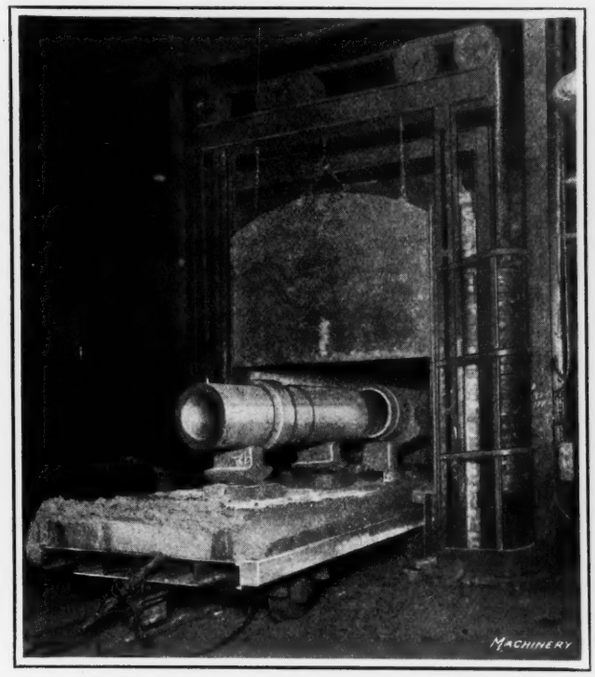


Fig. 11. One of the Car-bottom Furnaces in which Parts are heated for Drawing

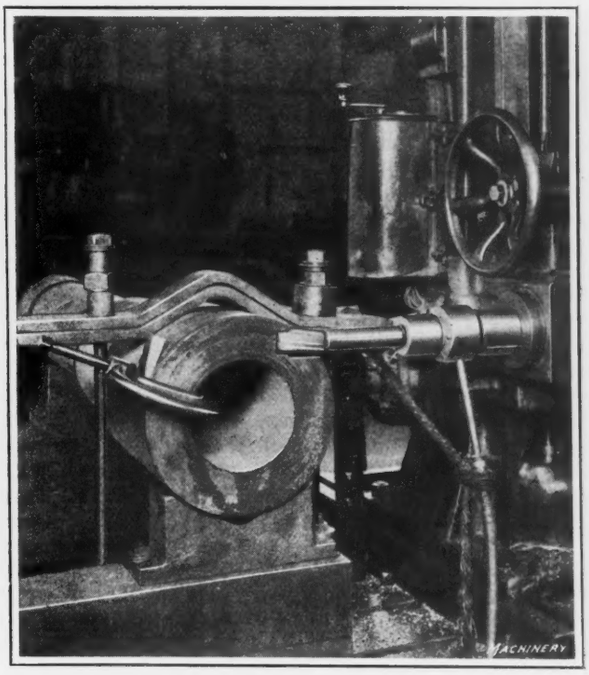


Fig. 12. Method of cutting a Transverse Test Piece from the End of a Forging

openings are located at various heights, and the number, as well as the location of those connecting with the heating chamber, is regulated by means of dampers operated from the different platforms seen at the side of the furnace. In this way a uniform temperature is maintained, and the degree of temperature can be varied as required.

The temperature in the furnace at all times is indicated by a recording pyrometer. This pyrometer is of the type which automatically and successively connects with the different thermo-couples in the furnace. The advantage of the recording pyrometer as applied to a heat-treating process of this kind is that it not only shows what the temperature is at any given time, but also the general trend of any changes of temperature.

The quenching requires only a few minutes, and the forgings are suspended from the crane and worked up and down to secure a more uniform cooling. By quenching them in a vertical position, the water rises inside the bore as the forgings are lowered into the water and a constant swiftly rising current is naturally obtained which makes for uniformity and rapidity of cooling. The forgings are not cooled completely in the quenching bath, but their temperature is reduced to about 500 or 700 degrees F.

Drawing or Tempering

When the forgings have been quenched from a temperature above the critical range, the tensile strength and elastic limit have been greatly increased, but the toughness of the steel has been reduced, and internal strains are also caused by the quenching and resulting contraction. For this reason the quenching is followed by an additional heat-treatment which is in the nature of a drawing or tempering process, the object of which is to relieve any strains that may have resulted from quenching and also give the steel the physical properties that are required. While forgings may be heated for drawing in the vertical type of furnace, horizontal furnaces are here employed. These furnaces are of the car-bottom, over-fired, oil-burning type. One of the smaller furnaces is shown in Fig. 11 charged with a hoop and three jackets, which are placed in a horizontal position upon the car that forms the bottom of the furnace. As the drawing process has been completed, this car is being pulled out of the furnace preparatory to removing the work and placing another charge on the car. The drawing process consists in heating the work to a temperature of from 1150 to 1200 degrees F. and holding it at this temperature until every section is heated uniformly. The forgings are then allowed to cool slowly in the furnace.

Tests to Determine Quality of Steel

The chemical and physical qualities of the steel for these gun forgings are determined in the laboratory, which is equipped with various modern appliances. At the time the ingot is poured, samples of the steel are secured by inserting small hand-ladles in the stream of metal as it flows from the ladle. The final tests are performed to determine the physical qualities of the steel, and they are made after the heat-treating processes; in fact, it is impossible to determine definitely whether the steel conforms to the required standards until most of the work on the rough machined forgings has been completed. The physical tests are made to determine the tensile strength, elastic limit, percentages of elongation, and reduction of area where the fracture occurs. Since the greatest strains are tangential, or in a direction tending to burst the gun, the pieces subjected to the tests are cut transversely so that they are tangential sections. The tubes, hoops, etc., are made long enough to allow for cutting out these test pieces, which are

secured as illustrated in Fig. 12. A floor-type boring machine equipped with a hollow-mill is used. The test piece secured is ground to a diameter of 0.505 inch and the distance between the measuring points is 2 inches.

These nickel steel gun forgings according to specifications must have a tensile strength of 95,000 pounds per square inch, and an elastic limit of 65,000 pounds per square inch. The minimum allowable elongation or stretch is 18 per cent, and the minimum reduction in area at the point of fracture is 30 per cent. If the tests show that the steel has the required qualities, the forgings are finally accepted by the Government and any additional machine work that may be necessary is completed. The amount of machine work done before making the physical test is limited as far as possible. The final machining operation and the assembling of the tubes, jackets, and hoops is not done at the plant of the Tacony Ordnance Corporation, as previously mentioned, as this concern specializes in the production of high-grade steel and rough-machined forgings.

* * *

SPLITTING PISTON RINGS

BY JACOB YOUNG

Splitting piston rings is an expensive operation in most marine repair shops. The lathe or boring mill is used to bore, turn, and cut the ring to the required diameter and width, after which it goes to the bench-hand by whom it is split and fitted. Rings of small diameter are generally fitted into the cylinder without being re-turned, whereas larger rings are usually re-turned after being split. In cases where the ring is fitted without being re-turned, the bench-hand fits the ring directly into the cylinder; or if the cylinder is not available, the ring is fitted into a hollow, cylindrical, cast-iron sizer bored to the diameter of the cylinder.

When the ring is to be re-turned after splitting, the problem of the bench-hand is to remove enough metal from the joint so that when the ring is fully compressed, the minor axis (which has now assumed an elliptical form) will be equal to the bore of the cylinder in which it is to work. To determine whether this condition obtains or not, he generally employs a wire end measure which has been filed or ground to the proper length, placing it in different positions on the ring so as to determine the position of the minor axis and the discrepancy (if any) which exists between the

TABLE 1. CONSTANTS FOR FORMULAS USED IN SPLITTING PISTON RINGS

$\frac{d_2}{d_1}$	K	$\frac{d_2}{d_1}$	K	$\frac{d_2}{d_1}$	K
0.900	0.155	0.940	0.093	0.980	0.031
0.910	0.140	0.950	0.079	0.990	0.016
0.920	0.125	0.960	0.063	....	....
0.930	0.109	0.970	0.047	....	....

Machinery

length of the gage and that of the minor axis. When these two lengths are equal, the ring, while still fully compressed, is securely pinned or clamped and removed to the lathe or boring mill for re-turning.

Method of Calculating Correct Length of Slot

The first problem that confronts the bench-hand is the amount of metal to remove from the ring. If he is a careful workman, he begins by cutting a small gap in the ring. He then compresses it by hand or by the use of piston ring clamps and forces it into the cylinder or, if it is to be re-turned, he measures its minor axis in order to estimate the amount of metal which must still be removed from the slot. In all probability the ring is still too large, so he repeats this process of hacksawing, filing, and testing, until the correct gap is obtained. This is the cut-and-try method, which is employed in most marine repair shops, where rings of all styles, diameters, and thicknesses must be made and fitted.

In order to reduce the labor required in this process as much as possible, the writer has derived two formulas for the two cases of piston rings previously considered, that is, those that are not re-turned and those that are re-turned after splitting.

Let d_1 = outside diameter of ring before splitting;
d_2 = cylinder bore; and
l = length of metal strip (measured along the outside circumference of the ring) which must be removed.

Returning to the first case where the piston ring is not re-turned after splitting, it should be noted that the outside circumference of the unsplit ring is πd_1, while that of the

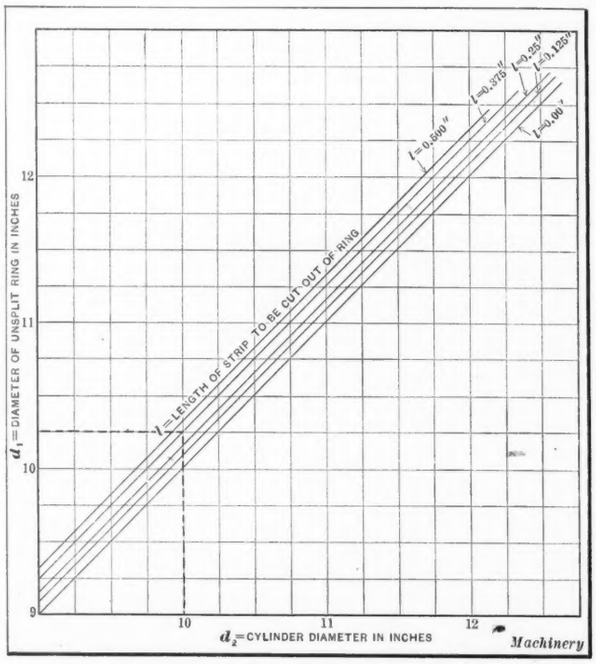


Chart for determining Length of Section to be cut from Piston Ring

ring, after it has been split and fitted into the cylinder or sizer, is πd_2. The difference between these two expressions is obviously the length of the strip of metal (measured along the outside circumference of the ring) which must be removed from the ring; that is,

$$l = \pi(d_1 - d_2) \qquad (1)$$

where π may be taken as 3.1. However, care must be taken not to use this rule when dealing with rings which are to be re-turned after splitting.

Example 1—A piston ring is turned to 12¼ inches in diameter and is to work in a cylinder 12 inches in diameter. How much metal must be removed from the joint if the ring is not to be re-turned? Substituting in Formula (1),

$$l = 3.1\ (12\tfrac{1}{4} - 12) = 0.78 \text{ inch}$$

Considering now the second case, where the ring is to be re-turned after splitting, it will be seen that after the ring is split and fully compressed, it is elliptical. The major axis of the ellipse is very nearly equal to the outside diameter of the unsplit ring, and the minor axis is equal to the cylinder bore. If the difference between the circumference of the unsplit ring and the perimeter of the elliptical ring which is ready for turning, is computed, the problem is solved, for the difference between these two quantities is simply the length of the strip (measured along the outside perimeter of the ring) which has been removed in the splitting process. The outside circumference of the unsplit ring is πd_1; the perimeter of the elliptical ring whose major axis is equal to d_1 and whose minor axis is equal to d_2 may be expressed thus:

$$\text{Perimeter} = \pi d_1 \left(1 - \frac{1}{4}e - \frac{3}{64}e^2 - \frac{5}{256}e^3 - \dots\right)$$

where $e = 1 - \left(\frac{d_2}{d_1}\right)^2$

The difference between the perimeters of the two figures is then

$$l = \pi d_1 \left(\frac{1}{4}e + \frac{3}{64}e^2 + \frac{5}{256}e^3 + \ldots\right) \qquad (2)$$

where l = the length of the strip (measured along the outside perimeter of the ring) which was removed in the splitting process. The numerical value of the expression within the parenthesis in Equation (2) depends simply upon the value of the ratio $\frac{d_2}{d_1}$, so that if we substitute different values of $\frac{d_2}{d_1}$ in this expression the equation will be reduced to a much simpler form, namely,

$$l = Kd_1 \qquad (3)$$

where K is a constant depending upon the value of the ratio $\frac{d_2}{d_1}$. In practice, the numerical value of this ratio will always lie between 0.90 and 1. Table 1 gives the values of K corresponding to different values of $\frac{d_2}{d_1}$. Knowing d_1 and d_2, we find the value of $\frac{d_2}{d_1}$, and by referring to Table 1 obtain the corresponding value of K; this multiplied by d_1 gives the desired quantity l.

Example 2—A packing ring 30.3 inches in diameter is to be split and re-turned to fit a cylinder whose bore is 30 inches. How much metal must be removed from the joint?

Here $d_1 = 30.3$ inches; $d_2 = 30$ inches; and $\frac{d_2}{d_1} = 0.99$

Referring to Table 1, we find the corresponding value of K to be 0.016. Using Formula (3) we have:

$l = 0.016 \times 30.3 = 0.485$, or approximately 31/64 inch

Charts for Determining Length of Slot

Where many rings of different diameters are to be split and re-turned, it may be advantageous to make diagrams or charts from which the desired quantity l may be obtained without the necessity of making any calculations. Such a diagram for rings from 9 to 12 inches in diameter is shown in the accompanying illustration. The vertical lines represent different cylinder diameters; the horizontal lines represent different diameters of unsplit rings; and the oblique lines, or lines of constant value, are those from which the desired quantity may be obtained. In using this or similar charts, the point of intersection of a vertical and of a horizontal line (either actual or interpolated) is determined; the location of this point of intersection with respect to the lines of constant value representing the unknown quantity l determines the value of that quantity.

TABLE 2. VALUES USED IN CONSTRUCTING DIAGONALS ON CHART

l, Inch	d_1, Inch	K	$\frac{d_2}{d_1}$	d_2, Inch
0.50	10.25	0.049	0.969	9.93
0.50	12.00	0.042	0.973	11.67

Machinery

Example 3—A packing ring is turned 10¼ inches in diameter. After splitting, it is to be re-turned to fit a cylinder 10 inches in diameter. Determine the length of the metal strip which must be removed from the ring. The graphical solution is indicated by the dotted lines in the diagram. The point of intersection of the horizontal and vertical lines is seen to lie on the line of constant value $l = 0.375$ or ⅜ inch.

This problem may also be solved by using Formula (3).

Thus $d_1 = 10\frac{1}{4}$ inches, $d_2 = 10$ inches, and $\frac{d_2}{d_1} = 0.976$

Interpolating for the value of K, we find $K = 0.037$

Then

$$l = 0.037 \times 10\tfrac{1}{4} = 0.379 \text{ inch}$$

which is very nearly the value obtained from the chart.

Construction of the Chart

The values given in Table 2 will show how the chart is constructed, that is, how the diagonals are located. In this particular case the 0.50-inch diagonal was laid out first. Two points are required for this purpose and with the values of l and d_1 assumed to be 0.50 inch and 10.25 inches, respectively, one of these points may be readily located. From Formula (3),

$$K = \frac{l}{d_1} = \frac{0.50}{10.25} = 0.049$$

Now a ratio which corresponds to 0.049 does not appear in Table 1, so by interpolation from the nearest value, 0.047, $\frac{d_2}{d_1} = 0.969$; that is, $\frac{d_2}{10.25} = 0.969$; and $d_2 = 9.93$ inches.

The intersection of the coordinates for these points 10.25 and 9.93 locates one point on the line $l = 0.50$ inch, and by a similar computation using other values of d_1 as, for instance, 12 inches, and the same value for l, the other point may be located, through which the diagonal may be drawn as shown. This process should be repeated using other values for l for finding the location of the other diagonals.

* * *

The present high price of coal in Italy, according to the Italian Bureau of Public Information, has resulted in the realization of an idea which at first thought seemed a practical impossibility, but which has been developed until it is assuming considerable importance; this is the industrial use of the natural heat emitted from the soil in regions more or less volcanic in character.

The first experiments along this line were made some years before the war in Tuscany near the salt-mines of Voltorra, in a region extensively covered with volcanic formations; here are found certain volcanic vents emitting jets of very hot steam containing boric salts and various gases used in the extraction of boracic acid. Instead of limiting the use of these steam-jets, as in the past, to extracting the salts contained, the ejection of the steam is stimulated by the boring of holes. In this way it is possible to obtain jets at a pressure of two or three atmospheres, according to the locality, and in some exceptional instances as high as five atmospheres, the temperatures varying from 150 to 165 degrees C. (300 to 330 degrees F.). These steam-jets maintain their force and temperature unchanged for many years, and they are not affected even when other openings, not too near each other, are bored in the ground.

In 1905, Prince Ginori-Conti applied this natural steam to a 40-horsepower engine. In 1912 an experiment was made in which a 300-horsepower turbine-alternator was used. Later, because of the enormous increase in the price of coal, it was decided to exploit the thermal energy of the gases on a much larger scale, but as other substances are emitted with the steam, among them sulphuric acid which corrodes metals, particularly iron, and therefore the engine cylinders in which the steam was to be used, it was attempted to use this steam only for heating. Three turbine-alternators of 3000 kilowatts each were installed, fed by low-pressure boilers, not heated by coal or other combustible fuel, but by the natural steam, superheated to 165 degrees C. (330 degrees F.), issuing from the ground and piped and carried to the boilers. Today there is in Tuscany a central power plant of 16,000 horsepower operating without interruption and distributing current to Florence and Livorno.

SPECIAL MACHINE FOR MILLING WRENCH SLOTS

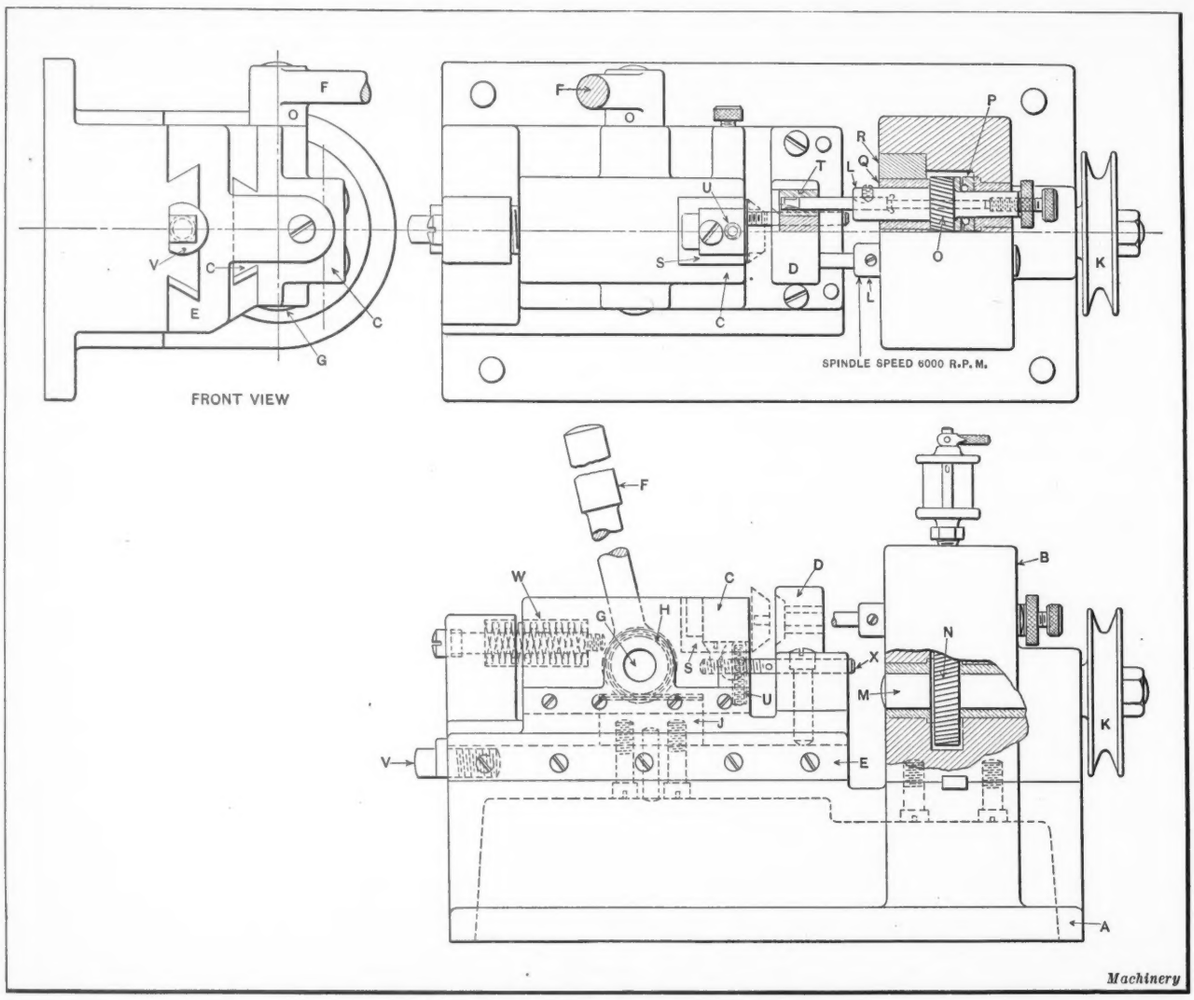
BY DONALD A. BAKER

A high-speed milling machine for milling the wrench slots in a French fuse is shown in the accompanying illustration. This machine consists primarily of a base *A* on which are mounted a head *B*, which carries the cutter-spindles and their driving mechanism, a work-carrying slide *C*, and a locating nest *D*, which is mounted on the slide *E*. Both of the slides are operated by one movement of the hand-lever *F*. This lever is attached to a shaft *G*, which is carried by the slide *C;* a pinion *H* attached to it engages with a rack *J*, which is attached to the base casting *A*.

The cutter-spindle head *B*, is driven by means of a round rawhide belt that passes over grooved driving pulley *K*. The two cutter-spindles *L* are driven from the main drive shaft *M* through a train of spiral gears *N* and *O*, the ratio being about 3 to 1. The cutter-spindles are hardened, ground, and lapped, and run in cast-iron or bronze bushings; the thrust is taken by special thrust ball bearings *P*. The spiral gears *O* are made a press fit on the spindles. In order to assemble, the front bearings *Q* are mounted in a separate plate *R*, which is fitted into the front of the head. This fitting is done before the holes for the bearings are bored so as to insure their being in perfect alignment. Provision is made for the adjustment of one cutter in relation to the other; one spindle is made hollow and is provided with a thrust rod which passes through it and which is fastened by an adjusting screw and lock-nut at its outer end. The cutters are held in place by cone-pointed set-screws, which engage a V-groove in the shank of the cutters. The cutters are made of drill rod of the correct size, the spindle being carefully ground to the correct size to receive them.

On the work-holding end of the machine a nest *S* of hardened and ground steel is provided, while a locating nest *D*, also of hardened and ground steel, is fitted to the slide *E*. This locating nest, in addition to providing a tapered surface into which the work fits, carries guide bushings *T* which help to support the cutters when they are presented to the work. A light spring plunger *U* aids in ejecting the work, as it pushes the work up to where the operator may more readily grasp it with his fingers after the slots have been cut.

To operate the machine, the operator first pulls back the hand-lever *F*. This draws back both slides *C* and *E* until slide *E* strikes against the head of the screw *V*, but slide *C* moves still farther back and allows a piece of work to be placed in the nest *S*. Then as hand-lever *F* is released, the spring *W* forces the slide *C* forward until the work is firmly seated in the locating nest *D*. Then the hand-lever *F* is pushed forward and the two slides, moving forward together, present the work to the cutters. The depth of the cut is regulated by an adjustable stop *X*, which strikes against the front of the cutter-spindle head. A two-lipped cutter is used and the spindle is run at a speed of 6000 revolutions per minute. These cutters cut so freely that it is impossible to force the work to them faster than they will handle it; therefore it is possible to produce six thousand pieces of finished work per day. Sight-feed oilers keep the spindle bearings properly lubricated. By operating these machines with a foot-treadle, both of the operator's hands are free to handle the work; this makes the machine operate still faster.



Machine for milling Wrench Slot in French Fuse

Training Women in an Airplane Plant

By James W. Russell, Director of Production Training, Curtiss Aeroplane & Motor Corporation, Buffalo, N. Y.

The demand for trained operators for the simpler operations on machine tools, while not as great as it was before the cessation of hostilities, will no doubt continue to require the permanent employment of women in many machine industries. By proper training, much better results can be obtained than by merely introducing women to shop work without any special preparation. The plan used at the Curtiss airplane plant will therefore be of interest to those who are intending to continue the use of women in machine shops for those operations for which they are especially fitted. An additional feature of the training school is its application to the training of disabled soldiers—a departure of the greatest importance, intended to provide for them a real place in our industries.

THE Curtiss Aeroplane & Motor Corporation of Buffalo, N. Y., for nearly a year past has been training women machine tool operators for single-purpose operations. Having been confronted with the problem of a serious shortage of skilled workers, the management decided to adopt measures for the installation of a production training school, under the guidance of someone who was familiar with industrial training methods. Consequently in March, 1918, a plan was proposed which called for an intensive program for the war emergency, and which was immediately approved and put into operation. Lathes, shapers, power and hand milling machines, and in fact nearly all kinds of machines, fixtures, and mechanical devices commonly employed in the mechanical industry were used for the training of women of all classes who applied for employment.

The Experiment and Its Result

The average machinist, no doubt believes that a boy of fourteen years, even if intensively trained in the fundamentals of the machinists' trade for two and one-half years, could not build and assemble a 12-inch lathe. However, experience has taught those who have made a study of this subject that with the proper type of instructors this is possible. Of course, the instructors must be versed in the practical as well as the academic side of their trade; otherwise such results could not be obtained.

When the attempt was first made to introduce women as lathe operators into the Curtiss plants, the question arose as to whether it was possible for a woman to run a lathe. In order to answer the question, a woman was carefully instructed on lathe operation in the production training school of the company. The greatest care was taken by her instructor to insure that she understood what the various handles, levers, stops, gears, screws, feed connections, wrenches and other parts of the equipment were used for. The purpose of the headstock, tailstock, and carriage was also carefully explained, previous to instructing her on the actual operation of the lathe.

The methods of centering work, straight and taper turning, chucking, boring, drilling, and reaming were readily grasped by the operator, as well as the use and reading of micrometers and scales, and the use of calipers. The regular production work was used by the trainee in her development. In a period of about two weeks, this woman was promoted to the metal-working department of the plant proper. Several weeks later, when the writer chanced to be passing through the department in which she was employed, it was noticed that she was engaged in cutting screw threads. Her foreman stated that she was as good an operative on the kind of work that she was doing, as any man that he had on production work.

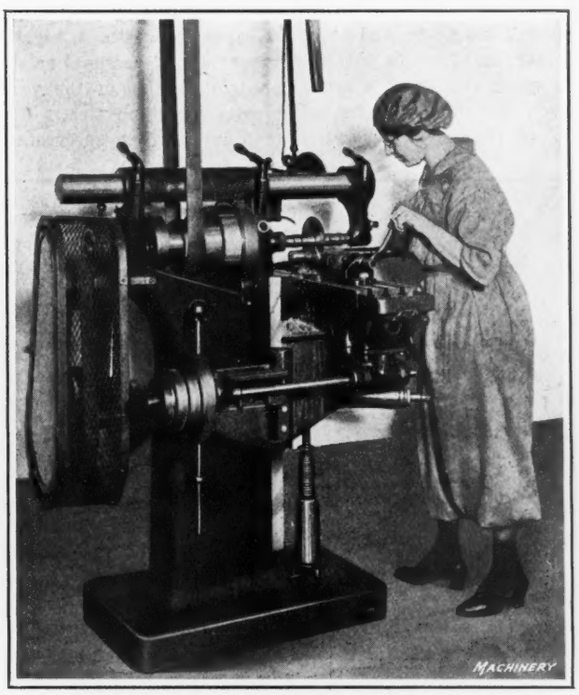


Fig. 1. Training Women in Simple Operations on Milling Machines in the Curtiss Aeroplane & Motor Corporation's Training School

Owing to the abnormal shortage of men, it soon became evident to all large manufacturing corporations that it would be necessary to encourage the entrance of women into their plants. The old and expensive plan of sending the newcomer to the foreman was first tried, resulting in the usual failure and a large turnover. The Curtiss plan soon demonstrated that the production training school method was the most economical, as the labor turnover showed a decrease from 50 per cent to 4 per cent, when a survey was made four months after the

Fig. 2. The Training School has made it Possible to teach Women in a Short Time how to operate Hand Screw Machines

Fig. 3. Turning Operations in the Engine Lathe within Accurate Limits are successfully performed by Women

practice of promoting trainees from the school into the plant was started.

Effect on Discipline

In addition to training women for the various activities on both wood and metal, the methods of discipline and decorum, as practiced unconsciously by the trainees, resulting from the environment of the school, injected this same spirit into the plant departments. This result is not always recognized for some time, but eventually it will be conceded that the help in general shows improvement and attends to its work more faithfully than formerly. It is the opinion of the plant manager that even if the girls are retained in the training department for only two days, they show the results of those two days and are better workers than the inexperienced girls. Even though a girl does not spend much time in the training department, her limited stay removes her fear of the shop and enables her to learn more quickly when actually placed on production in the plant.

Selection of Instructors

Special care is necessary in selecting the teachers. They must, of course, be well experienced in their trade, and able to express themselves understandingly in order to intelligently impart knowledge; and they must also be of a sympathetic nature. Women are the best instructors to be in direct contact with other women, as the newcomer will naturally feel that if one woman can do the particular work at hand, she can also do it.

In selecting men instructors, great care should be exercised, for their character must be above reproach. They also must be of an altruistic nature and should enjoy helping the inexperienced to do better work. One instructor can handle from eight to fifteen trainees, depending of course, up on the character of the work. The method pursued changes somewhat according to the occupation, but the teacher always explains in detail the function of the machines or tools before starting the trainee to work. Whenever the operator makes an error while in training, she is corrected in a kindly manner and encouraged to do her best.

Introduction into Training

Employes are sent directly to the training department of the Curtiss shops from the employment department, and there are no previous indications or evidence as to their individual capabilities. The training department organization, through its system of vocational guidance, is capable of selecting the job for which the girl seems best fitted, or the best fitted girl for a particular job. The applicants are received by a refined, highly qualified woman, who acts as a supervisor of personal relations. The trainee is then placed on trial in one of the various activities for which she is mentally and physically adapted, or which she has chosen to follow. When successful, she is promoted to the produc-

Fig. 4. Girls are also trained to perform Oxy-acetylene Welding Operations

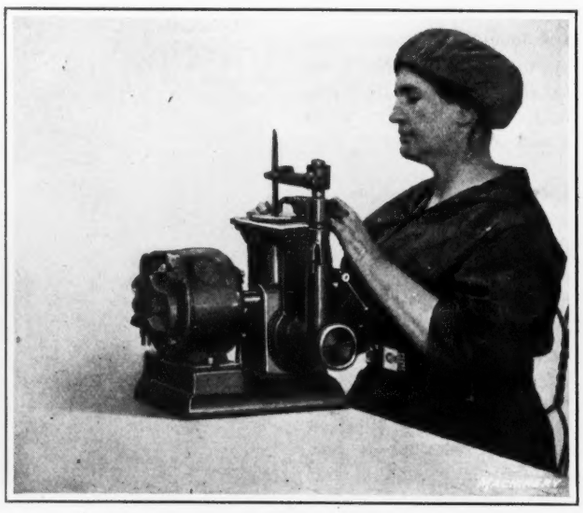


Fig. 5. The Operation of Motor-driven Filing Machines is especially Suitable for Women

tion floor and works thereafter under the regular shop foreman. If the girl shows a lack of ability or adaptability while in training, or if she finds that the work disagrees with her, she can at once be transferred to some other class of work. It is obvious that this feature of the system retains many women who would otherwise become dissatisfied and leave if handled under the old system, and thus add to the already enormous turnover of labor in the industries.

The Follow-up System

After the school had been open only a few weeks, it was learned that upon promotion, girls were seeking a change in occupation through the departments of the plant. This caused an additional expense, since the foreman of the department to which the change was made had to break in a newcomer again. As soon as this state of affairs was discovered, a follow-up system was established, and a close personal relation with the girl was gained. Then, by ascertaining the cause of her uneasiness, and if a good and sufficient reason should be given, she would be required to return to the training department to be trained along a different line, thereby saving the "breaking in" expense. This method

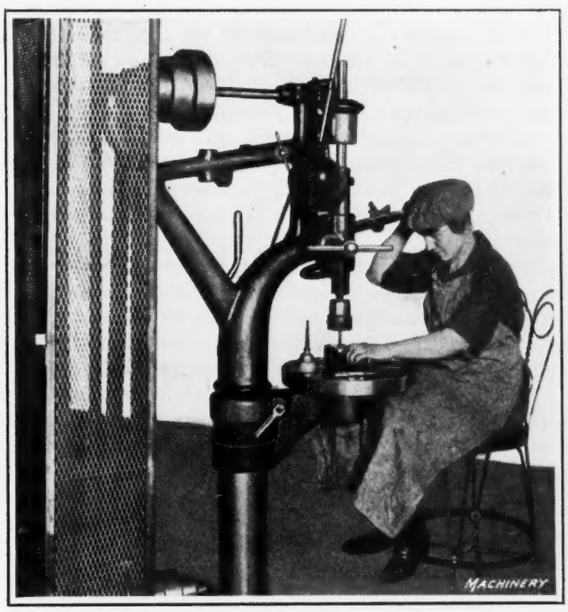


Fig. 6. Drilling Machine Work involving the Use of Jigs

teaches the girl that she cannot drift about from one department to another for any trivial reason, but it also shows her that when she is dissatisfied her case is not beyond remedy, and that she can return to the training department which always stands ready to retrain her. This attitude of the training department greatly reduces the number of employes who leave unnecessarily.

Nature and Scope of the Work Handled by the Department

The work turned out in the training school is a part of the regular production, and must pass inspection. Therefore, the trainee knows that she must be careful, accurate, and speedy before she can justly expect to be promoted into the shop at a higher wage-rate. Since its organization last March, the training department has promoted over 2000 operatives into the plant. A program has recently been outlined to increase the activity of the training department so that 400 girls can be trained at one time, and 2500 girls will be promoted into the plant in a period of three months.

In addition to the training for all the machine and metal work, the activities of the training department cover other occupations of the aircraft industry, such as work on panels, stabilizers, elevators, rudder assembling, linen covering, and beam mill work, as well as numerous other carpenter jobs, including boat hull parts, structs, propellers, and assemblies.

The training of women inspectors for metal and wood parts is covered practically as well as academically. Girls are taught to read blueprints and to use machinists' measuring tools, such as the micrometer, scale, calipers, bevel protractor, etc. A course in tracing has also been in effect for several months which covers a period of three weeks' intensive training, whereby the average girl can qualify for a position as a tracer in the engineering department.

Training Cripples

An interesting experiment, and one which may result in a humanitarian as well as an industrial undertaking, has been tried out in the department with marked success. This is the training of cripples. As an illustration of the manner of handling this phase of the training, a man who had lost his left arm at a local steel mill was successfully trained as a painter, a side trapping having been devised to hold the paint pail. Other physically defective persons were trained for soldering, filing, etc. A remarkable case, where great benefit was derived by this experiment, is that of a seafaring man, fifty years of age, who had lost one leg. After being employed, he was instructed and developed

Fig. 7. Girl performing Work of the Tool-room Variety in a Shaper

through the medium of the training department in the art of acetylene welding and brazing. Although awkward at first with the torch and tools, more on account of his age than his affliction, he was put on regular production work in the shop after a few weeks' training, and continued to do excellent work. This experiment and its gratifying results have demonstrated the possibility of a development of training for the returning soldiers of the Army who have been incapacitated through wounds or accident.

* * *

TRAINING SCHOOLS FOR APPRENTICES

According to a report of the Training and Dilution Service of the United States Department of Labor, there has been a marked increase in the number of plants which maintain special organizations adapted to training workmen for their own immediate needs. Although a few progressive plants have maintained apprentice schools for some years, there has been no general adoption of this method in the past. However, the Department of Labor reports that there are now more than 200 apprentice or training schools in active and successful operation. The effect of these organizations upon American manufacturing will be of great importance, and their development should be of unusual interest to everyone connected with the machine tool industry.

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Associate Editors

THE BRITISH EMBARGO

The announcement by the War Trade Board that after March 1 machine tools would be listed by Great Britain as a prohibited import, at first seemed a very drastic measure; but later it was explained that the machines and other products on the prohibited list may be imported under special license, making it evident that the British Government has no intention of cutting off imports of machine tools, except in certain instances. Recognized British importers will obtain permission to receive machinery regularly in proportion to the amount they imported to Great Britain before the war. During the period of greatest trade restrictions—while the war was going on—well-established firms always were allowed to export enough machinery to keep their agencies going, and it is now hoped that they will be permitted to carry on an even more substantial trade. It is only the new concerns that have not been importers in the British market in the past that are likely to find the gates closed to them for some time to come. The British realize that this prevents trade which, in some instances, would be desirable; but industrial and economic after-the-war conditions make it necessary to adopt the new restrictions, which are said to be purely administrative, instituted to meet present emergencies in Great Britain, and in no way intended as a trade war policy or as unfriendly to American manufacturers. Doubtless internal industrial conditions in England make it desirable for the Government at this time to keep close control over imports of machinery and other products likely to be in direct competition with British industries now changing from a war to a peace basis. The British Government is clearly endeavoring to facilitate these great and important changes, and the present restrictions will doubtless be removed or greatly modified when the necessity for them passes.

* * *

TRAINING THE CRIPPLED AND DISABLED FOR SELF-SUPPORT

On another page of this number our readers will find an interesting article by the director of the Red Cross Institute for Crippled and Disabled Men in which he outlines the methods pursued in placing men disabled in war or industry in a position to support themselves and remain useful and self-respecting members of the industrial world. This organized effort to qualify disabled men to fill useful places in industry has been badly needed, but only the great war and the consequent large number of men returning disabled from the battle front could have aroused the necessary interest. We know that in the United States between 30,000 and 35,000 men and women are killed annually through industrial accidents, but we have no reliable statistics to show the number of men and women disabled through accidents in the industries. Judging by the number of accidents that are fatal, it is reasonable to assume that the number causing temporary or permanent disability is annually greater than the number of disabled men returning from the war. The organized effort now being made by the Red Cross and other agencies, partly with governmental and partly with private support, deserves the highest commendation. It is of the greatest importance that those who are injured in the industries should be taught the trades they can follow with the least possible handicap thereafter. It has been conclusively shown at the Ford plants that there are a great number of occupations in the machine building industries for which men more or less seriously disabled are suitable, and it has been found that they can fill such useful places and earn their pay, when properly selected and taught, as well as their more fortunate brothers. By systematic efforts to train these handicapped men, a great and needed service is rendered both to them and to the community.

* * *

ACCURACY IN MACHINE WORK

During the war, a great deal of time was wasted in our machine shops through insistence upon a degree of accuracy quite unnecessary—that is, too small tolerances—in many tools and devices required in the manufacture of war material. This practice was not always due to the inexperience of non-mechanical men. In many instances, the excessive accuracy—with the accompanying loss of time and effort—was due to pride of workmanship on the part of manufacturers and their skilled workmen.

Accuracy is all right in its place, and, when required, the skill, patience, and persistence that will produce highly accurate work is worthy of the highest commendation; but to finish a gage to a tolerance of a tenth of a thousandth of an inch, when one-half of a thousandth of an inch would have been quite satisfactory, is a foolish waste of time, and absolutely inexcusable when speed is so important as it was during the past year.

Now that we are again turning to peaceful efforts, our manufacturers and workmen should give thoughtful study to the question of tolerances in machine work. If a little more time were spent in attaining the highest degree of accuracy where accuracy is vital, and there were less refinement where it is non-essential, the quality of the product could be improved, while its cost could doubtless be considerably reduced. The same applies to producing highly finished surfaces, where finish is not required. In the past, small jigs and fixtures were often finished all over; now only the surfaces that require a finish are machined.

Toolmakers and gage-makers are especially prone to sacrifice economy to their pride of workmanship. During the war, it was not uncommon to hear gage-makers exclaim: "But that is not gage-making," when they were told that a gage made with a tolerance of one-half of a thousandth of an inch would be accurate enough for its purpose. We live in a competitive age, and must aim only for practical results. It is not for mere accuracy we should strive, but to make things sufficiently accurate to serve the purpose for which they are intended. The largest permissible tolerance is the right tolerance. That principle, and that only, should guide the decision as to the tolerances in machine work.

Machine Tool Trade in Northern Europe

BY S. E. OSMAR

President and General Manager of Galco, Ltd., formerly G. A. Lindstedt & Co., Stockholm, Sweden

The author of this article, who is closely in touch with the business and financial side of the machine tool industry in Sweden, recently arrived in the United States with a view to arranging for agencies for the leading American manufacturers of machine tools and accessories. The conditions as described by him are founded on an intimate personal knowledge with the machine tool trade in the Scandinavian countries and with the conditions in general in northern Europe, including Finland and Russia.

IT is evident that the industrial conditions in the Scandinavian countries are in a somewhat unsettled state, because the sudden conclusion of the war had, of course, an industrial effect upon the Scandinavian countries similar to that in America—that is, there was a complete change in the requirements, and hence a reconstruction period, which, by no means, is over at this time. The machine tool trade, especially, has been in a peculiar position in Sweden during the last four years, and it will probably be another year before fully normal conditions may be expected.

Machine Tools Built in Sweden During the War

During the past four years, the Scandinavian countries have been unable to obtain American machine tools to meet the demand. This is especially true of the last two years, during which time practically no machine tools whatever have been exported from America to these countries. In the early part of the war, the demands for machine tools in Russia were also tremendous, and these demands could not be met by American machine tool builders alone, who were at the time the only ones in the world's market who were in a position to export. As a result, the few then existing machine tool building firms in Sweden began to build complete lines of machine tools, and, in addition, a great number of new firms entered the machine tool business. These firms would build any kind of machine for which there was a demand. They copied American and German designs outright, but the quality of the machines built was far below that of the American original. However, the conditions, both in Sweden and in Russia, were such that the machine tools had to be obtained, irrespective of quality and price. The demand from Russia was responsible for such a boom in the machine tool building business in Sweden that shops without the slightest experience in this line sprung up over night, as it were, and began to copy the highest class of American precision machine tools. The results can be imagined. Even in Norway, which, in the past, has built practically no machine tools whatever, factories sprung up engaged in this line of manufacture. The same was the case in Denmark, and, as a matter of fact, the quality of the machines built by inexperienced makers in Norway and Denmark was even poorer than that of the machines built in Sweden.

One of the curious facts in connection with this copying of American and German machine tools is that, in many cases, old models were copied. A collection of circulars illustrating all the different types of machine tools made in the Scandinavian countries during the war period shows machines copied from the models of American makers that were brought out here fifteen years ago, or more, all the way down to the most modern designs. Apparently, if the builder happened to have in his own plant an American machine tool bought in the year 1900, he merely took that machine apart, made detail drawings of the whole machine, and built it. He had, of course, no opportunity to copy a modern machine of the same make if he did not have it in his possession at the beginning of the war, and so he did the best he could—copied the old model as it stood.

Effect of the Russian Revolution

Then, when the machine tool building boom was at its height and contracts had been placed by many machine tool dealers in Sweden with the scores of small firms that had started in this business, the Russian revolution came. Immediately the demand from Russia fell off, and the many dealers in Sweden, who either through greed or lack of foresight had placed large contracts for inferior machine tools, found themselves cut off from the market and with enormous stocks of a poor quality of machines on their hands. As the contracts are very large and permit of no cancellations, some of them are still being filled by the builders. Today, therefore, there are a number of machine tool dealers in Sweden who are in a difficult financial position on account of having a large unsalable stock on their hands. While of poor quality, these machines would sell in Sweden as long as the war lasted, because it was impossible to obtain machines from abroad, but now that the war is over, the quality of most of these domestic machines will prevent them from being sold except at prices that would mean a substantial loss.

Prices of Machine Tools in Sweden

During the war, and even up to the present time—importation from America having as yet not been resumed—the prices of machine tools have been exceptionally high. Present prices in the United States are considered high by many, but these prices are low as compared with those that have obtained in Sweden during the past two years. The inferior copies of American and German machines that were placed on the market during this period have been sold at prices from 50 to 100 per cent in excess of present prices of American machine tools. These high prices were necessitated by the high cost of materials and the costly manner in which the machines were built—a few machines only being put through at a time, and every shop apparently attempting to build a full line of machine tools, from lathes and screw machines to milling machines and planers. The raw materials were also excessively

EXPECTED DEMAND FOR MACHINE TOOLS IN THE NEAR FUTURE

The classes of machine tools that will be most urgently needed in the near future are those required in railway and marine repair shops, in plants building locomotives and railway cars, marine engines, and in shipyards. In all of Europe, the rolling stock of the railways is in a poor condition and needs to be repaired and replaced. This will require machine tools of the heavier types, as well as bolt, nut, and rivet machinery, which latter class is especially in demand by the shipyards. Another class of machinery that will be required all over northern Europe is agricultural machinery, and factories for the building of such machines are already being established. The machine tools for these factories will be imported and will furnish an important item in the export trade of America.

high. Pig iron sold in Sweden for a price nearly three times the maximum price in America, and cast iron and steel at more than double the price. Wages have risen so that they are now as high as wages in the United States.

With the signing of the peace treaty—or possibly before that time—prices, however, will most likely break. The inferior machine tools with which so many of the less far-sighted machine tool dealers are stocked up must be sold at any price; and while the customer would much prefer buying a machine that he knows is of first-class quality, the temptation to buy these inferior imitations will be very great if they are sold at a price substantially less than imported machines.

Competition with American Machine Tools During the Next Few Years

For a few months to come, the inferior domestic machines that doubtless will be sold at low prices will offer, in some instances, a serious competition to imported machines, but after that period has passed, there will be little or no competition with domestic machine tools, because, under normal conditions, the scores of firms that have sprung up in the last four years will be unable to compete either in quality or price with American-built machines, and will go into other lines of business. At the present writing, the indications in Germany are that there will not be any serious competition from that nation either, in regard to machine tools. The conditions prevailing in Germany indicate that there will be unrest for a long time to come, and when the nation finally settles down, it is probable that the country will be fairly well divided up into a number of moderately socialistic republics, whose governments will neither have the capacity nor the desire to further the foreign trade in as aggressive a manner as did the ex-imperial government.

Although France is expected to be, in the future, the most important industrial nation in Europe, on account of the natural resources which will pass into French hands as the result of the peace treaty, any serious competition in machine tools from France is unthinkable for many years to come, because France has no machine tool industry of any account at the present time, and it is reasonable to expect that it will take a long time for the French nation to build up such an industry, because the Frenchman naturally moves slowly and leisurely. The most serious competition will be with England, but even that competition will be one that the American machine tool builders can meet on an equal footing, because wages are now high in England and are likely to remain high, and while the British efforts are now directed toward specialization in the industry with a view to reducing manufacturing costs, these efforts will hardly carry the industry to the efficiency of the American plants for many years to come.

Important Considerations in Holding Scandinavian Market

It must not be forgotten, however, that England is nearer the Scandinavian countries than is America, and it is easier for the British manufacturer to fill an order quickly. It therefore becomes necessary for competing American builders to keep a stock of machines in Sweden, especially in the case of smaller sizes, so that orders can be filled quickly; otherwise even if the customer should prefer the American-made machine tool, he might buy the British product because he could obtain it almost immediately.

Another matter that must not be overlooked is that a satisfactory arrangement of credits must be provided, rather than the cash payments against the bill-of-lading insisted upon by most American manufacturers of machine tools previous to the war. European manufacturers of machine tools will extend reasonable credits to the dealers, and American manufacturers must make arrangements to extend the same credit facilities. This is mainly a matter for the banks, however, because if the American banks will discount the bills of well-known Scandinavian dealers, that is all that will be required. The Bureau of Commerce of the United States should also have commercial attachés in the leading trading centers, whose main business it should be to keep the United States government, and through the government the industries of the United States, confidentially informed as to the business standing of dealers abroad who ask to have credits extended to them. It would be preferable to have a disinterested agency, if properly conducted, handle this investigation and information service, because sometimes the European bank that is a correspondent of an American bank may, for certain financial and business reasons, give information that might be prejudicial, although unjust, to the firm under consideration.

Future Market in Russia

The conditions in Russia are such that it is impossible to even guess at the length of time that will elapse before the country is again in a stable condition. Even the best informed men who have access to confidential information of the Allied governments with regard to the situation in Russia are not in agreement as to the actual situation in that country. Some believe that the Bolsheviki government is weak and that a comparatively small Allied force could end its rule; others, again, claim that the strength of the Bolsheviki government is much greater than ordinarily believed and that it has a very firm hold on all Russia, excepting Siberia, the extreme north, and the region close to the Black Sea.

Whatever the conditions, however, it is evident that sooner or later the nation must settle down to an orderly condition, and when that time comes almost everything in Russia in the metal working field will need replacement. Practically all over Russia, except in a few works used by the Soviet government for the making of war materials, factories have been entirely dismantled by the Bolsheviki in order to gain access to the small amounts of brass, bronze, or copper used in the construction of the machines. These metals, which command a high price at the present time, have been shipped mostly to the nearby neutral countries and sold as scrap. The appearance of this scrap indicates that the machines have been broken to pieces, simply to obtain the more valuable metals used in their construction. In the same manner, it is said that practically everything of value has been destroyed, and when the war is over, the reconstruction that will be needed in Russia, will require machine tools and machinery of all kinds. The opportunities for extended trade activities will be enormous, because, after all, Russia is a rich land in its natural resources, and as soon as the delirium is over and the people settle down to work again—which they simply must do within another year, if they are not all going to starve to death—they will be able to pay with raw materials for the manufactured products that will be required to put the country back again among the civilized nations. Of course, some scheme of international financing will be necessary to facilitate this reconstruction.

German Activities in Sweden

The activities of German business interests in Sweden during the past two years have been very noticeable. The German interests have realized that, after the war, they will be in a very difficult position in regard to foreign trade. Several German concerns, therefore, have established agencies in Sweden with a view to selling their products under Swedish names and as if manufactured in that country. One large and well-known German electrical concern has made plans to build large factories in Sweden, where presumably machines will be assembled, the parts being made in Germany and shipped to Sweden for that purpose. Whether the Swedish government will take some action with regard to these attempts to carry on German trade under the protection of the Swedish flag is not yet known, but it is reasonable to expect that if the Swedish government does not take such steps, the Allied governments will include measures looking toward this end in the conditions of readjustment that will be part of the peace treaty.

It is doubtless that it would be very tempting to the financial interests in Germany to transfer some of their activities to Sweden in case the new German governments should become very socialistic in their tendencies. In the machine tool field, however, it is not believed that these activities of the Germans will have any appreciable effect. It is the electrical field and the general manufacturing fields that will be more likely to be affected.

Agencies for Machine Tools in Sweden

The writer believes that it is highly important that American machine tool builders carefully select the agencies that are to represent them in Sweden now that the war is over. Conditions have materially changed during the past four years, and the firms that were leaders previous to the war are not necessarily the leaders now. Some have injured their reputation by handling machine tools of the very poorest grades, thinking apparently of nothing else than how to make the greatest amount of money in the shortest time, and ignoring entirely the effects on the future. New dealers have come to the front who have become recognized for their integrity and care in handling their business. It is for the American machine tool manufacturer to make careful inquiries into the business reputation of the various firms that might be selected to represent him, and then to make his choice upon the basis of the results of such an inquiry. To go by pre-war impressions would be erroneous. There has been a new deal all around, and as the future of the American machine tool trade in the Scandinavian countries is of the greatest importance to the writer personally, he wishes to impress upon the American machine tool manufacturer the necessity of thoroughly inquiring into the present character, reputation, and financial responsibility of the agent that will represent him in the Scandinavian countries from now on.

Previous to the war, the American manufacturer did not seem to care greatly whether his agent worked hard to sell his machines or not; as long as he got a few orders every now and then, he was satisfied. As a matter of fact, most of the machines were sold not so much because of the efforts of the dealer as because the customer wanted a certain make of American machine tool. In other words, the customer bought the machine—the dealer did not sell it. A new era is now at hand when American machine tool builders will expect real results, because the foreign trade is going to be a great factor in the future of the machine tool business.

* * *

STANDARDIZATION IN SPECIAL MACHINE DESIGN

BY F. E. JOHNSON

The slow and inefficient old-time methods of producing parts were not adapted to the production of interchangeable parts for a machine or device, as the practice was to lay out much of the work using only a few special tools, jigs, or fixtures, and those of the simplest forms. These methods made it necessary to machine such members as required accuracy, in the order in which they were assembled into a machine, which was a slow process, and required much fitting, filing, chipping, etc. As the demand for machinery of various kinds increased, it became imperative to improve production methods. Improvements in the various existing types of machine tools, particularly in milling and grinding practice, advanced at a rapid rate. New types came into existence, including semi-automatic and full automatic machines such as the screw machine and turret lathe.

Developments in jig, tool, and fixture practice followed as a consequence. Today in our best plants that turn out a product in large quantities, unnecessary time and labor is not expended in assembling operations. The various parts are machined so that they are interchangeable and ready to be secured in their respective positions. The larger concerns, such as those manufacturing motor cars, sewing machines, etc., whose output in a month or year is of enormous proportions, found it necessary to install equipment of a highly specialized nature. An example of this type of equipment is found in the plant of a certain sewing machine concern which has in operation a large turret or indexing machine, for machining the bed-plate or base upon which the needle-bar arm of its product is secured. The operations performed on this machine are numerous, and include milling, drilling, tapping, facing, counterboring, etc., so that a finished piece is produced at intervals of one minute, or the time required for the longest operation. This is carrying methods to a point where the average manufacturer cannot follow, because his output of parts does not demand such advanced means. In order to attain and retain this manufacturing efficiency, it was necessary for such concerns to standardize their product, and to avoid making changes in it that would greatly disturb the operation of the system.

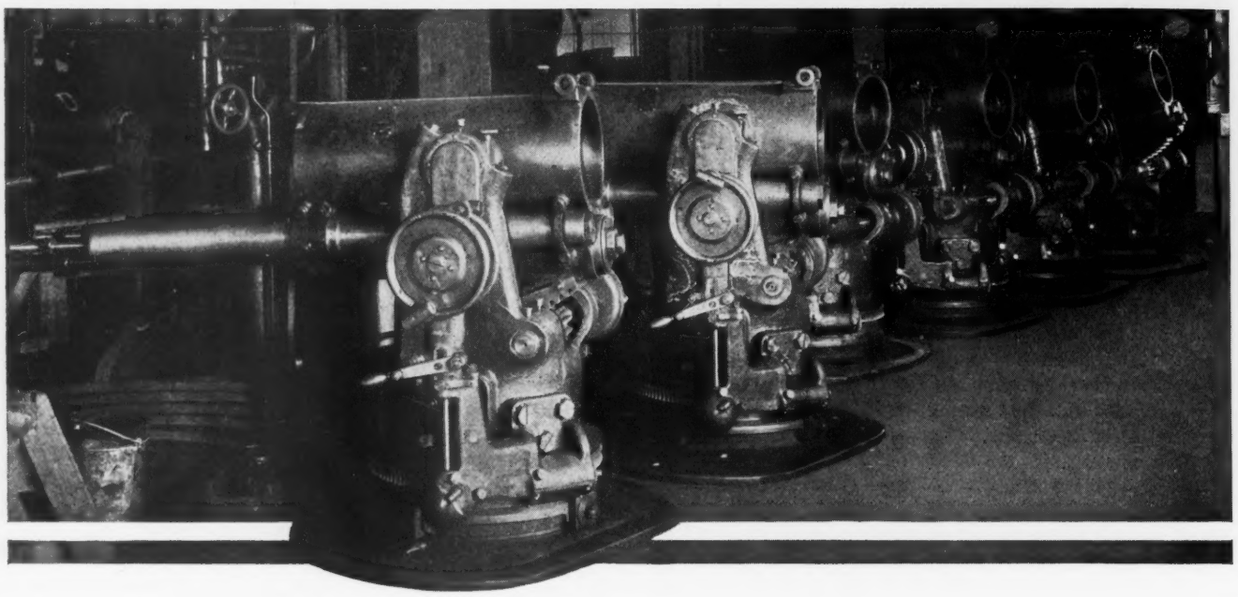
Evolution of Tool Designing Department

The smaller manufacturer, whose product is not so well known or is not developed and perfected to a point where he can safely standardize it, requires a system that is more flexible. It is not so many years ago that tool engineers, tool designers, and tool designing departments did not have a place in the manufacturing scheme. The problem of designing a tool or fixture was handled by the tool-room foreman, who made the necessary drawing—if one was required. The value of machining parts accurately as a factor for improving the quality of the output and reducing costs soon became generally recognized, and consequently the tool-design phase of the work was put on a more systematic basis. What is good or bad in small-tool practice has been so generally discussed in recent years that as a result certain means and methods have been accepted as standard practice. Types of jigs and fixture bodies, mechanisms, and various parts have been standardized, and are kept in stock by some concerns, so that a designer may utilize them when it is practicable, and thereby reduce the costs for such work. Well defined principles or rules as to the main points which should be considered by a designer have been evolved as a result of the collective experiences of many mechanics, and in machine tool design general principles of construction have been established.

Standardization of Mechanisms for Performing Similar Functions

The matter of standardization in special machine design has not received so much attention. At the present time widely varying means are used by different designers to perform a common or similar function. Although each may be individually successful, some means are undoubtedly less efficient or more expensive than others. A more definite knowledge of what would constitute a reliable means of performing a certain function which could be considered as a standard would be of decided benefit.

When we consider the expense and time required to design and build even a very simple machine, it is evident that a proper method of handling the problem is essential. The single-purpose machine tool is rapidly becoming a greater factor in manufacturing methods. Quantity production of parts is a means of reducing manufacturing costs, selling prices, and hours of labor. The full automatic, or one that is equipped with some form of magazine or self-feeding device constitutes the best possible means for producing parts in quantities, as one operator may care for several machines. In many cases it is possible to produce machines of this type so that by standardizing certain mechanisms or parts, they may be adaptable to a number of uses for a particular class of work, to the same extent that the screw machine and turret lathe serve in their particular field. By substituting cams, fixtures, tools, or magazines it can be made to cover a considerable range of work.



Making Naval Gun Mounts

Second Installment of an Article Describing Special Tools, Gages and Fixtures Used at the Plant of the Mead-Morrison Mfg. Co. where 1000 Complete Mounts for 4-inch Guns are Being Constructed for the United States Navy

BY FRANKLIN D. JONES

THE preceding article on this subject, published in the February number of MACHINERY, dealt principally with the special fixtures and tools used for machining the slide, carriage, and stand of 4-inch gun mounts. Some interesting and ingenious special equipment is required for producing the sight- or sword-bar, which is an important part of the sighting mechanism, and this equipment will be described in the present installment.

The sight-bar is very difficult to machine, partly because of the accuracy required and partly because of the nature of the machining operations. It is necessary that all bearing surfaces have the same accuracy and grade of finish as is required in the manufacture of gages. The radial or circular surface of the sight-bar must also be so nearly perfect that the sight may be operated through its complete range of adjustments for elevation and azimuth (horizontal movements) without any binding action and without perceptible lost motion between the moving parts. The curved surfaces of the sight-bar and of the bearing in the sight-bar bracket must be exactly concentric with the axis of the pivot about which the sight moves in elevation. The sides of the sight-bar must also be exactly parallel and in a plane at right angles to the pivot. These and other exacting requirements make this a very interesting although difficult part to produce on an interchangeable basis, and it was necessary to design special radius milling fixtures and gages such as will be described in the following.

A general idea of the nature and extent of the work done on this part may be obtained from Fig. 18, which shows the sight-bar at five different stages of completion. There are twenty-one distinct machining operations on this member. The rough drop-forging is shown at *A*; the forging after the straddle-milling operation is shown at *B*; at *C* the sight-bar has had the sides rough-milled to the correct radius, and some work has also been done upon the head or projecting part at the upper end; at *D* the sight-bar has had the channel or groove milled in one side; and at *E* is shown the finished product. There are, of course, intermediate stages of completion which are not shown by these illustrations.

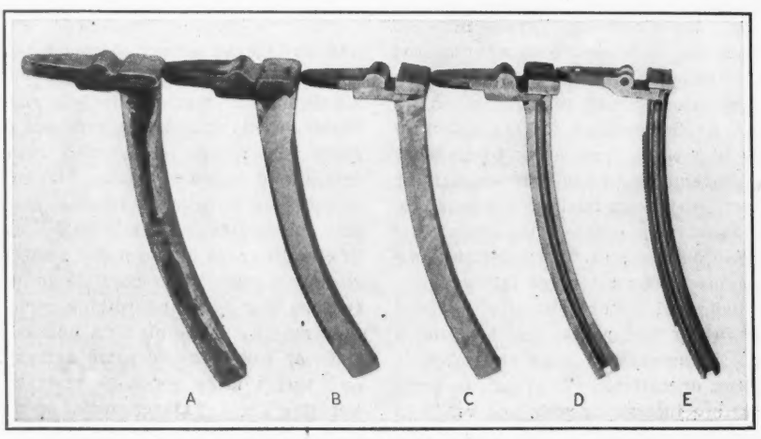


Fig. 18. Rough Drop-forging for Sight-bar at the Left and its Appearance after Successive Machining Operations

Straddle-milling and Gang-planing Operations on Sight-bar

The first operation on the sight-bar is to rough-mill the sides as illustrated at *B*, Fig. 18. This operation is performed by a heavy column-and-knee type machine equipped with straddle-mills for machining both sides of the bar simultaneously, as illustrated in Fig. 19. While this is a roughing cut, the sides are machined parallel within close limits, which enables the work to be located accurately in the fixtures used for subsequent operations. The fixture for straddle-milling is of very simple design, and consists principally of a casting curved to fit the lower supporting surface of the sight-bar forging. The head of the sight-bar is held against a plate at the end of the fixture and is secured in place by an ordinary clamp.

The method of gang-planning the

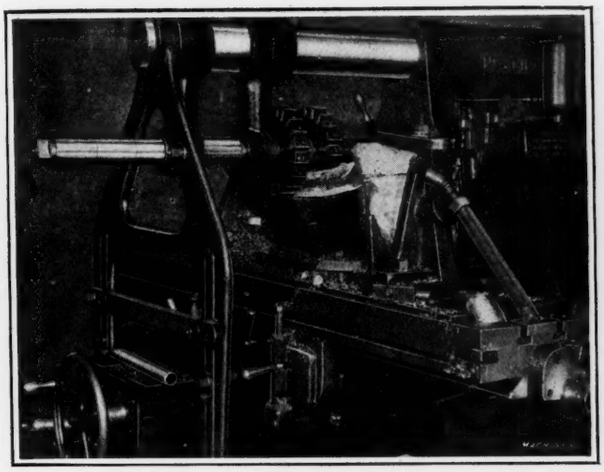


Fig. 19. Straddle-milling Sides of Sight-bar Forging

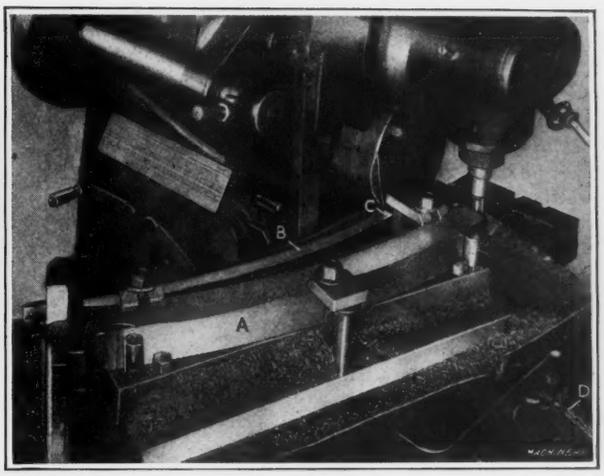


Fig. 20. Rough-milling a Circular Slot in the Sight-bar

heads of the sight-bars after the straddle-milling operation is illustrated in Fig. 22. Twenty-four sight-bar forgings are planed at one time; four cutting tools are used, two being held in the side heads while two are attached to the heads of the cross-rail. The sight-bars are located at right angles to the length of the planer table by the milled sides, one side of each bar being held against a vertical surface on the fixture, as shown in the illustration.

Rough-milling Slot—Radius Milling Fixture for Sight-bar

The slot which is milled in one side of the sight-bar, as shown at *D* and *E*, Fig. 18, is rough-milled as illustrated in Fig. 20. The sight-bar *A* is held on a fixture having a slot *B* in the rear side of the same radius as the slot to be milled. A block *C*, which is free to swivel and is pivoted to a stationary part of the machine, engages slot *B*. The cross-feed screw in the knee is removed, and as the table is fed in a lengthwise direction, a slot is milled to the same radius as the slot *B* in the fixture. A weight is attached to the saddle of the machine by means of a wire cable which is connected at *D*. The object of using a weight is to hold block *C* in contact with the slot on one side, and thus by eliminating all play it is possible to secure a higher degree of accuracy. A two-lipped end-mill is used for this operation. The slot is milled 0.8 inch wide and 1⅝ inch deep.

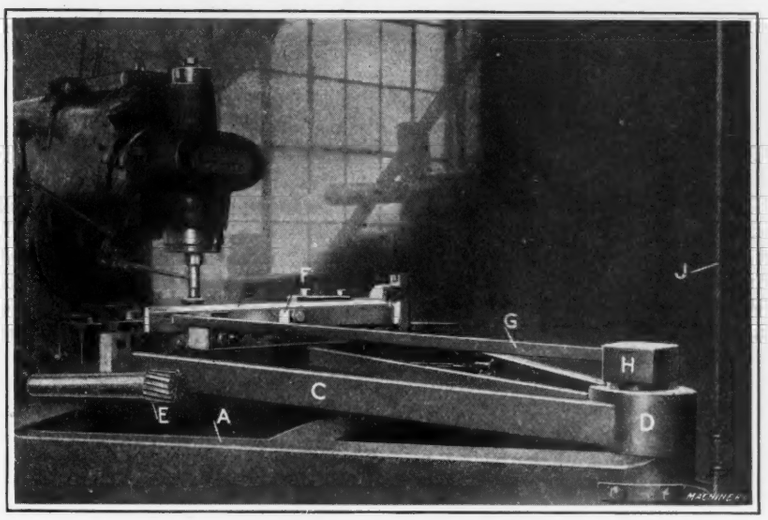


Fig. 21. Radius Milling Fixture used for Different Operations on the Sight-bar

The curved sides of the sight-bar and also the beveled surfaces along one edge are milled by means of a radius fixture of the type shown in Fig. 21. This general style of

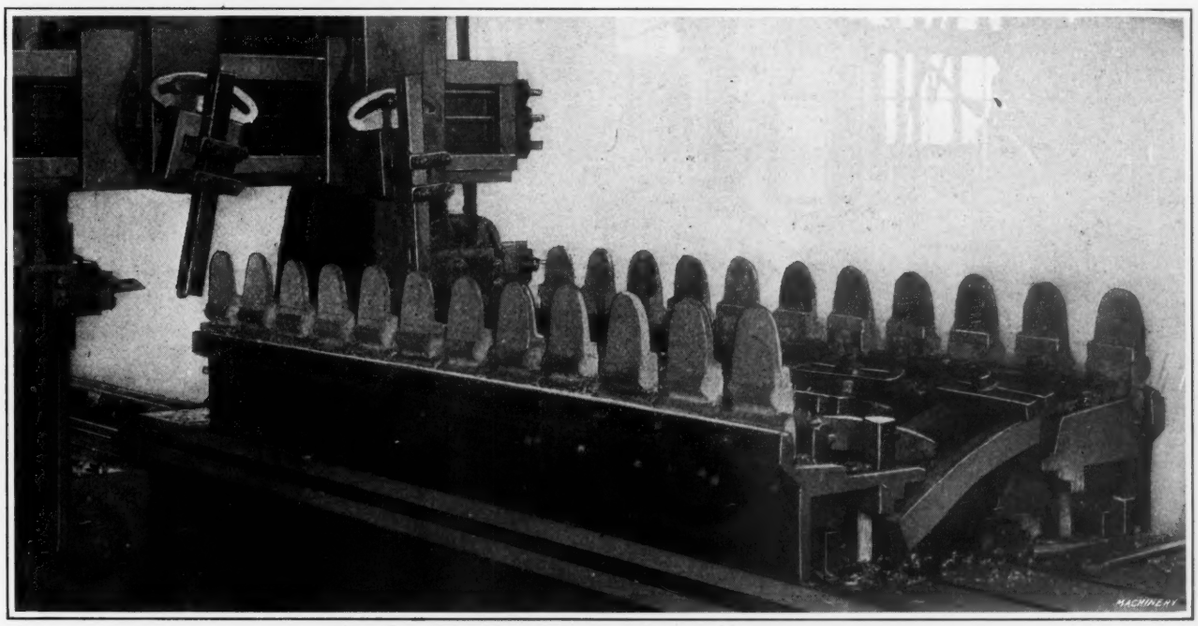


Fig. 22. Gang-planing Twenty-four Sight-bar Forgings

fixture is used extensively in connection with other operations on the sighting mechanism. It has a very heavy base casting *A*, which is bolted to the table of the machine. The sight-bar *B* is held onto the swinging part *C* of the fixture, which is pivoted at *D*. At the work-holding end of the swinging member there is a swiveling nut through which passes a feed-screw. This feed-screw is connected by gearing located at the end of the table with the regular feed-screw of the machine, the nut in the milling machine having been removed; consequently, when a sight-bar is being milled, the part *C* of the fixture is given a circular movement about the pivot *D* as the power feed traverses it from one end of its swing to the other. The illustration shows the machine milling the beveled edges on the top of the sight-bar. When the sides are being milled, the cutter shown at *E* is used. After one side has been milled, the stops *F* are transferred to the opposite side so that they will not interfere with the cutter. The gage used for testing the radius of the inner surface forms part of the fixture, and consists of a bar *G* which is free to slide through a block *H*. This block is also free to turn about the same pivot which is used for the swinging part of the fixture. The radius of the sight-bar is tested by bringing the gage point into contact with it and then noting the position of the end of bar *G* relative to the outer surface of block *H*. When the end of the bar and the surface of the block are exactly in the same plane, as indicated by tests made with a dial gage, the work is correct. The sight-bar is located in the fixture by the finished face of the head, which also serves as a common locating point for many other operations. In designing the fixtures for holding the sight-bar, special attention was paid to the question of providing adequate rigidity, and as a result the parts are unusually heavy. There is considerable overhang of the fixture relative to the machine table, and in order to avoid sag, the overhanging part is counterbalanced by a heavy weight attached to one end of the wire cable *J* which passes over pulleys fastened to the ceiling.

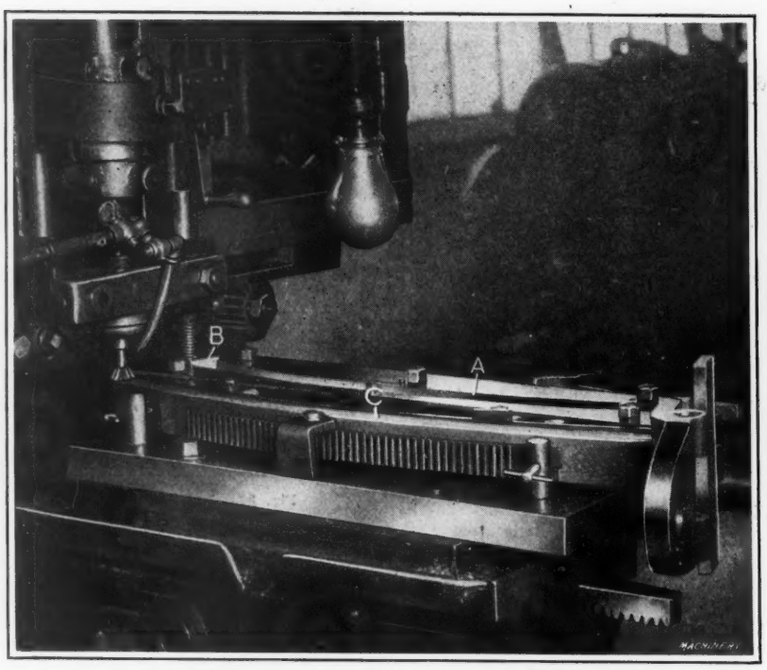


Fig. 23. Profiler arranged for milling a Circular Dovetailed Groove

Circular Milling Operation on Profiling Machine

The method of using an ordinary profiling machine for milling a circular dovetailed channel in one side of the sight-bar is illustrated in Fig. 23. This channel is for receiving the German silver graduated strip which indicates the range at which the sight mechanism is set. While it would be possible to perform this operation by means of a radius milling fixture similar to the design described in connection with Fig. 21, the profiler is used in preference for this operation because it is more rapid and it enables the larger and more expensive milling machine used for radius milling to be engaged on more productive work. The profiling fixture has a curved channel or slot *A* on one side which is engaged by a swiveling block *B* so that a dovetailed channel *C* of corresponding radius is milled in the side of the sight-bar.

Fig. 26 illustrates another application of the profiler in connection with machining the sight-bar. The operation in this case is simply that of milling the edge of the head to

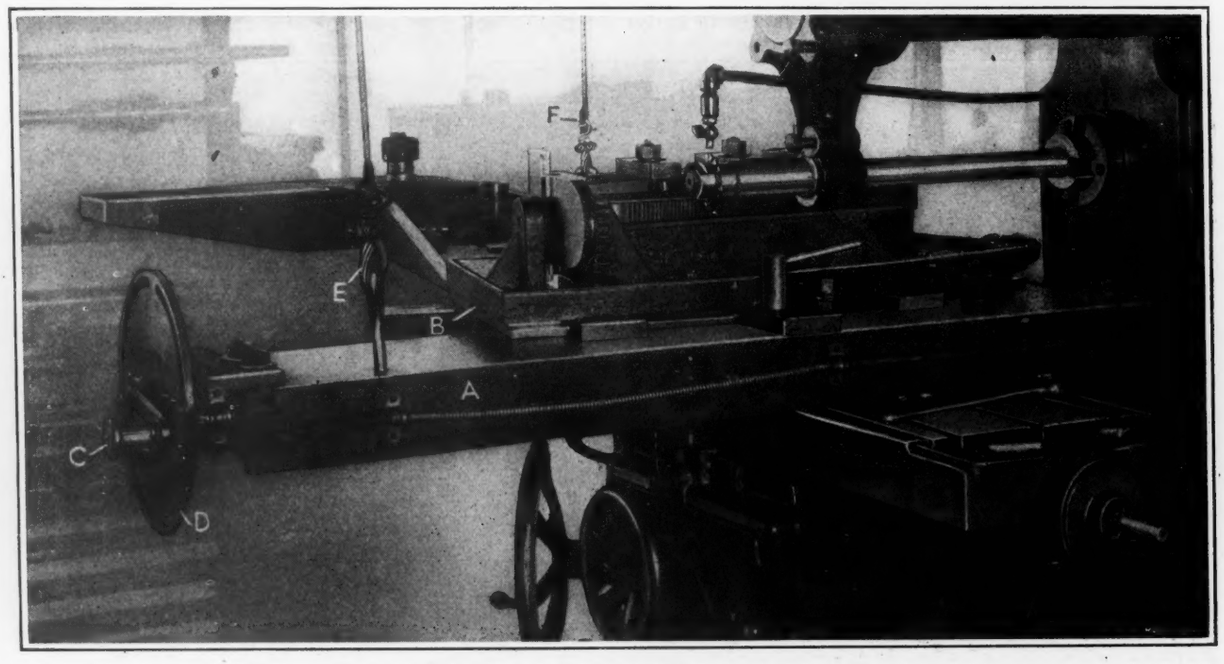


Fig. 24. Radial Indexing Fixture for cutting Gear Teeth in Sight-bar

the required contour. It will be seen that the path followed by the milling cutter is controlled by a former plate *A*, which is engaged by pin *B* in the usual manner while cutter *C* mills the curved edge on the sight-bar.

Milling Rack Teeth in Sight-bar

The sight-bar and the other parts of the sight mechanism which are attached to it are elevated or lowered through a pinion which engages teeth cut on one side of the sight-bar. These teeth must be very accurately spaced; in fact, the total tolerance or allowable error in the fifty-five teeth of the sight-bar is only 0.0005 inch. The fixture used for milling these gear teeth is illustrated in Fig. 24. The gear teeth on the sight-bar do not form a rack, but rather the segment of a gear, since the pitch line is an arc; therefore, the radial type of fixture is employed. The base *A* is bolted to the machine table, and the swinging part *B* is pivoted at the rear end. Beneath this swinging part there is a segment of a worm-wheel, and meshing with it a worm carried by the shaft of the indexing mechanism. The indexing crank *C* connects with this worm-shaft through spur gearing. The sight-bar is clamped to an adapter plate, which is replaced by another adapter when the same fixture is used for milling operations on the yoke as will be described later. The sight-bar is located in part by the finished surface of the head, as is the case in the other operations. As it would be difficult, if not impossible, to construct a large fixture of this kind and eliminate all measurable error, the original inaccuracy is eliminated as far as possible in order to reduce the error in spacing the teeth to a minimum. The method of compensating for this original error is as follows: When indexing the fixture a distance equivalent to one tooth space, crank *C* is turned one revolution or until its spring pin again comes around into mesh with the hole in the disk shown. Since there are 55 teeth in the sight-bar, and as the total original error was a few thousandths inch large, this error is compensated for by turning the indexing disk *D* backward an amount equivalent to 1/55 of the original error. There are really two indexing movements, therefore, for each tooth space, the same as in compound indexing. A gear tooth caliper of the vernier type is used for testing the tooth thickness; the spacing is verified by placing pins between the gear teeth at each end of the segment, and also at intermediate points, and then measuring the distance between the pins by using a vernier caliper. The counterbalancing weights are also used in conjunction with this fixture, the attached cables *E* and *F* passing over pulleys above. These weights not only counterbalance the overhanging parts of the heavy fixture, but also make it easier to elevate the knee for feeding the cutter down past the work.

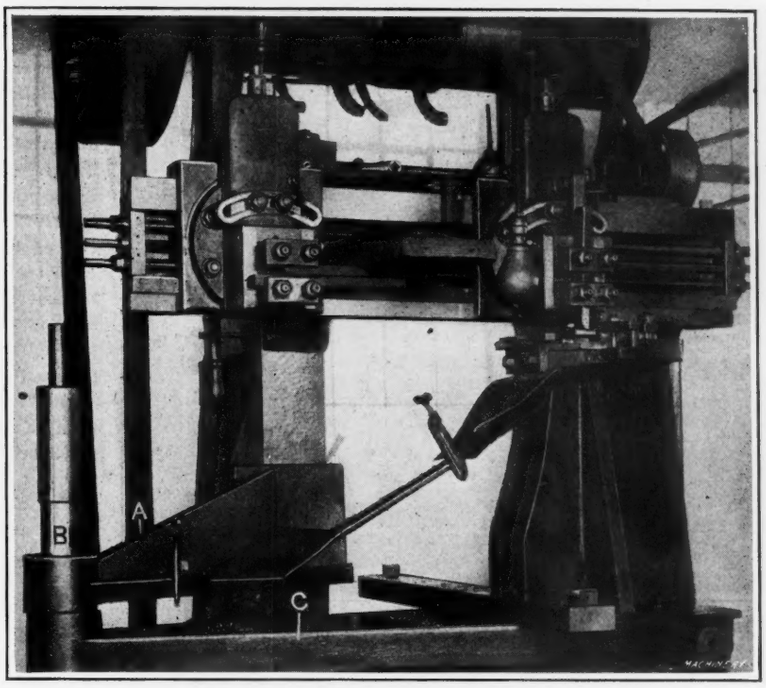


Fig. 25. Radial Planing Fixture for Sight-bar

Radius Planing Fixture

By referring to view *E* in Fig. 18, it will be seen that one end of the sight-bar head is finished to circular form. These

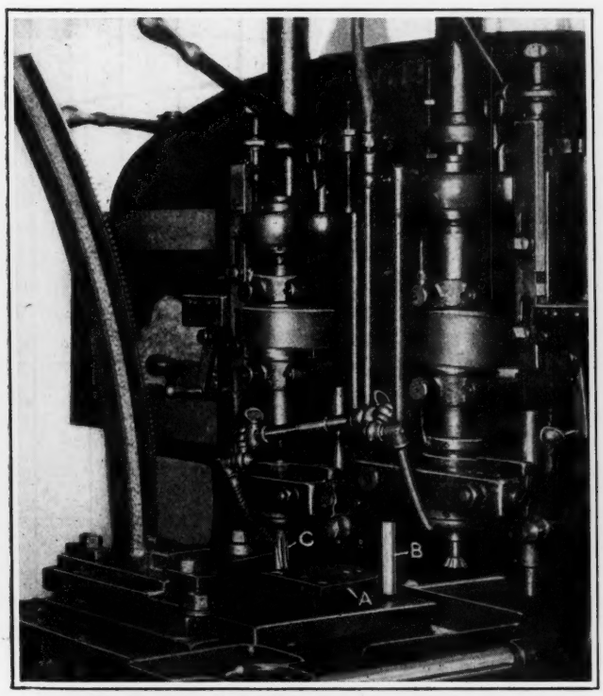


Fig. 26. Profiler set up for milling Curved Edge of Sight-bar Head

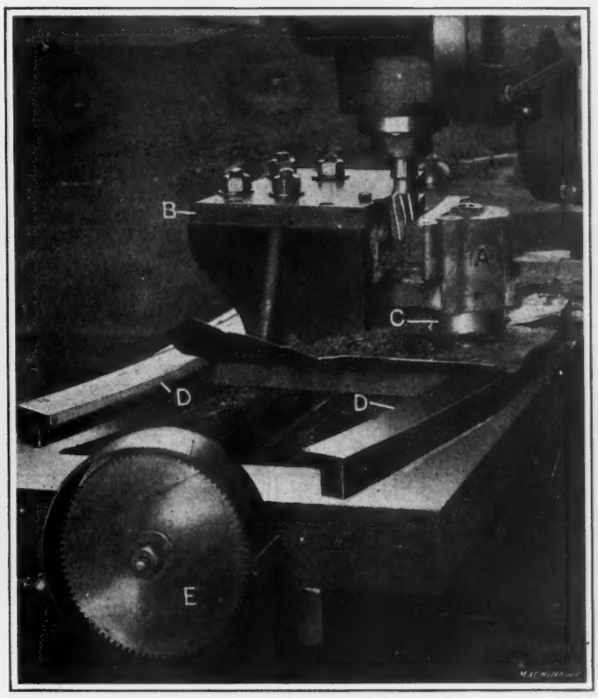


Fig. 27. Fixture for milling Curved Slot in Sight-bar Bracket

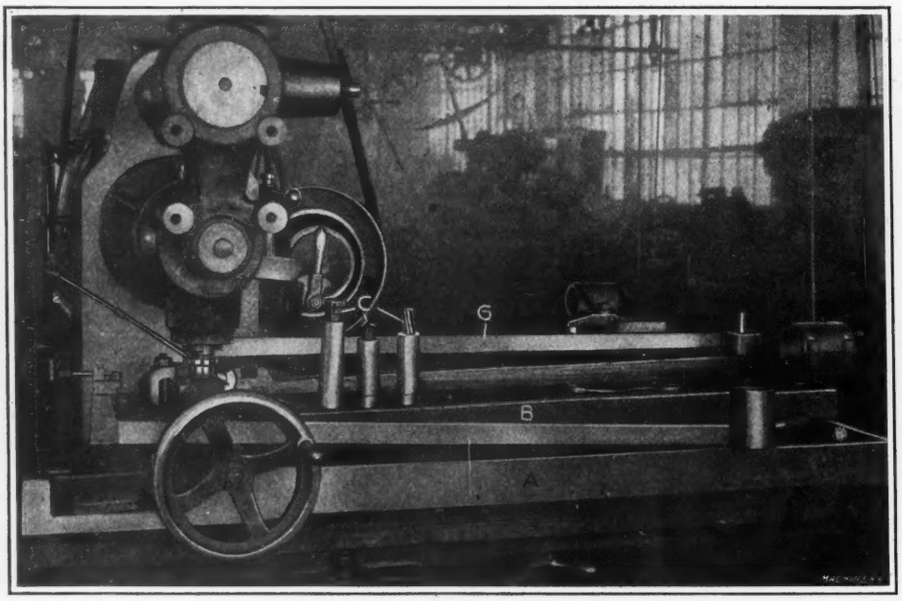


Fig. 28. Radius Fixture for Milling Operations on Yoke

surfaces are machined on a planer equipped with a special radius fixture as shown in Fig. 25. An arm *A* is rigidly attached to one of the planer housings and carries a shaft *B* which forms the pivot for the swinging part *C* of the fixture. This swinging member has a slot on the rear side which is engaged by a pivoted block which moves to and fro with the planer table; consequently, the sight-bar, which is held to the swinging member in an upright position, follows a circular path and is planed to a circular form, the radius of any surface being governed by the horizontal distance from the cutting edge of the tool to the axis of pivot *B*. This fixture is similar in principle to some of the forms used in locomotive shops for planing the links of the valve-operating mechanism.

Milling Curved Slot in Sight-bar Bracket

The bronze bracket through which the sight-bar slides when being elevated or lowered, has a curved slot which must be milled to the same radius as the sight-bar to avoid any cramping or binding action. A finished surface on the bracket *A*, Fig. 27, is clamped against a top plate or bridge *B* of the fixture, and it is further located by a plug *C* at the right. The base of the fixture fits between curved tracks or guiding strips *D*. At one end of the fixture a transverse slot is formed, and this is engaged by a block pivoted to a nut through which the feed-screw passes. The feed-screw is connected by gearing *E* with the regular feed-rod of the machine, and as the movable section of the fixture is fed along, a slot is milled to the same radius as the tracks.

Machining Operations on the Yoke

The yoke of the sight mechanism is a cast-steel member which carries the telescopes at its forward end and is attached at the rear to the sight-bar. This yoke is free to swing about horizontal and vertical pivots at the forward end which must be exactly at right angles to each other. The horizontal pivot is utilized when adjusting the sight in elevation, and the vertical pivot for setting the sight in azimuth or for horizontal adjustments. When making adjustments for elevation, the sight-bar simply slides through its bracket, whereas horizontal movements result in a circular turning movement of the yoke relative to the head of the sight-bar. There are some interesting radial milling operations on the rear end of the yoke, as well as other machine work which is of an unusual nature, due to the degree of precision involved.

Radius Milling Fixture for Yoke

The curved surfaces at the end of the yoke are milled to the required radius by a type of fixture which, in many

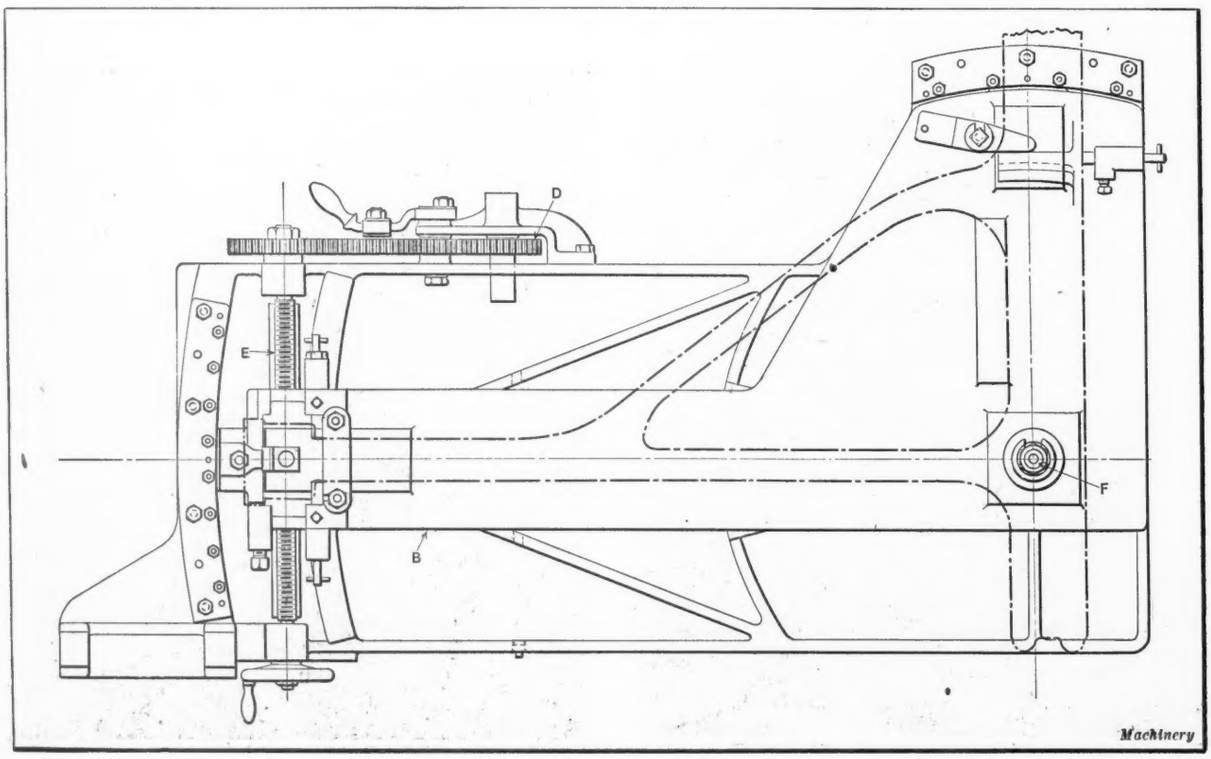


Fig. 29. Plan View of Fixture shown in Fig. 28

respects, is similar to the radial designs already referred to in connection with the sight-bar. The base *A*, Fig. 28, is bolted to the table of a column-and-knee type of milling machine, and the upper part *B* is free to swing about a pivot located at the required radial distance. The operation shown in this particular illustration is that of form-milling the worm-gear segment in which worm teeth are cut later to mesh with a worm which enables the yoke to be adjusted horizontally. Several other curved surfaces are also milled with the same fixture, the cutters used for the other operations being shown at *C*. The swinging member of the fixture is provided with both a hand-operated and automatic feeding movement. The latter is derived from the regular feed mechanism of the machine. The universally jointed shaft, originally designed to transmit feeding movements to the work-table, was disconnected and arranged to drive the feed-screw of the fixture through a train of spur gearing. The construction of this fixture is shown more clearly by the plan view, Fig. 29. The universally jointed shaft drives gear *D* which, through the other spur gears shown, revolves a feed-screw *E*. This feed-screw passes through a swiveling nut connected with the swinging part *B* of the fixture which is pivoted at *F*. The yoke is indicated in this illustration by the heavy dot and dash lines. The type of radius gage used in conjunction with this yoke milling operation may be seen by referring to Fig. 28. The gage *G*, shown in place on the fixture, is used for testing the radius of the worm-gear segment being milled. The gaging end corresponds to the curved surface of the segment, and the opposite end is placed over a pivot that is in alignment with the main pivot about which the fixture swings. Another radius gage seen at the front of the fixture is placed on the pivot previously referred to, and has a micrometer head for measuring the radius at the end of the yoke where a spur gear segment is formed.

* * *

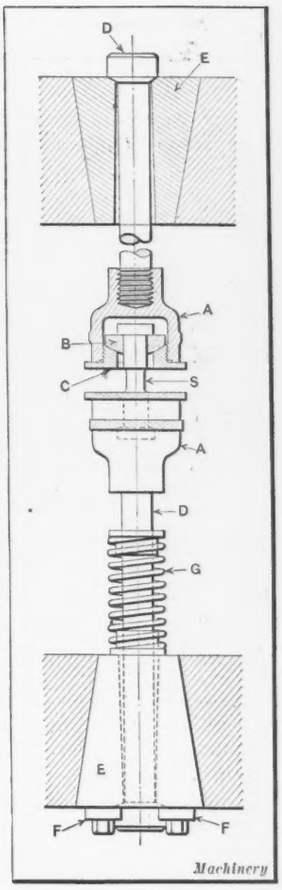
TENSILE TESTS OF CAST IRON AND SEMI-STEEL

By H. L. CAMPBELL, Metallurgist, Industrial Works, Bay City, Mich.

Although cast iron and semi-steel are not to be recommended for use where tensile strength is of prime importance, tensile tests of these metals serve as a guide in determining their physical values. When the structure of the metal is such that high tensile properties are obtained, it is certain that other tests likewise will indicate high strength. A transverse test involves both tension and compressive forces, and since the strength in compression of cast iron or semi-steel is much greater and varies to a less extent than the tensile strength, the tests in pure tension may be used as a basis for comparing the actual physical conditions of these metals.

Tensile test bars are usually cast separate, although they may be poured with the castings which they are to represent. When the test bars are attached to the castings, care should be taken to see that the conditions as to the feeding of the metal and the rate of cooling are the same for the test bars and for the casting. Turned bars give more satisfactory results than specimens which are tested in the form in which they are cast. It is difficult, if not impossible, to obtain cast test specimens that are of exact dimensions and free from irregularities.

For tension tests of cast iron and semi-steel, it is important that the forces be applied only in tension, as any components in transverse directions will depreciate the results. In order to accomplish this, a set of special test-bar holders has been made which insures positive alignment of the test bar and the forces applied. As shown in the accompanying illustration the holders *A* consist of a coupling, inside of which is a ball and socket joint. The extended head of the test bar rests upon a split washer *B* which forms the ball of the joint. A holding nut *C* screws into the coupling and serves as the socket. The holders are fastened to two bolts *D* each of which is provided with a ball head. These bolts pass through wedge-shaped blocks *E*, one of which is set into the head and one into the carriage of the testing machine. Each block has a turned recess at the large end to form a seat for the head of the bolt. A tapered hole in the block allows free movement of the bolt during the test. The lower wedge-block is held in place by clamps *F* which are attached to the carriage of the testing machine. In order that the shock on the testing machine may be resisted when the test bars break, a spring *G* is provided around the lower tension bolt. This spring is made of ¼-inch wire and is fastened to thimbles at each end, as shown.



Special Holders for testing Tensile Strength of Cast Iron and Semi-steel

In preparing for a test, the halves of the ball washer are placed around each end of the specimen *S* and into the sockets of the holding nuts, which, in turn, are screwed into the couplings. The standard tensile test specimen is turned from cast bars, which are approximately 1½ inch in diameter and 4¾ inches long. The only accurate machining that is necessary is on the central portion, which is made 1 inch square. As it is not desired to measure the elongation or reduction of area of these bars, the length of the square central section is relatively short. The other portions of the specimen are made of just sufficient length to fit into the holders. By the use of extended heads on the test specimens instead of the commonly used threaded ends, the saving in machining time amounts to fifteen minutes for each bar. The chief advantage of this holding device is in the use of the ball and socket joints, which insure a pure tension test of the metal.

* * *

Felix S. S. Johnson, American consul at Kingston, Ontario, Canada, directs the attention of American manufacturers to the frequent omission on their part of the prepayment of import duties on catalogues mailed to other countries. They should first ascertain the customs regulations of the country to which the trade literature is addressed. By ignoring these regulations, many costly catalogues are either destroyed or returned to the senders. American firms contemplating sending catalogues to Canada should comply with the strictly enforced regulations governing the delivery, within the Dominion, of trade literature through the mails in bulk. Trade catalogues and price lists not designed to advertise the sale of goods by any one person in Canada may be sent duty free in single copies addressed to firms in Canada and not exceeding one copy to any one individual for his own use and not for distribution. Large numbers of valuable catalogues mailed to Canada by American manufacturers have been returned undelivered, owing to the refusal of the addressees to pay duty thereon. Catalogues and advertising matter sent in bulk as ordinary merchandise are dutiable. The total value of all the separate pieces of matter should be first ascertained and duty paid. Each piece of matter should have written or stamped on the outside wrapper or envelope, the words "Duty paid."

The Manufacture of Standard Thread Measuring Wires

BY FRED R. DANIELS

THE use of the three-wire system for measuring threads and thread angles has become so general that the manufacture of standard wires for this purpose is now an industry in itself. The B. Seaboldt Corporation, 25 West Broadway, New York City, is a pioneer in this line, and after much experimentation has developed interesting methods and equipment for use in the manufacture of these wires. The care required in the process by which these wires are made is not generally appreciated, and should, therefore, prove of particular interest to the thread gage manufacturer and to the toolmaker in general.

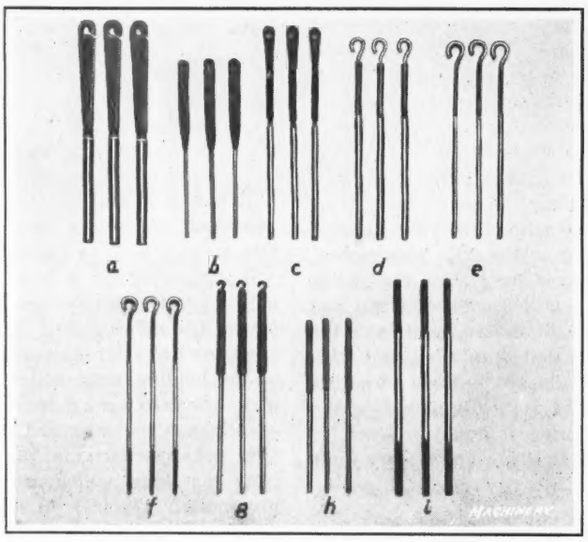


Fig. 1. Various Styles of Standard Thread Measuring Wires

Cutting off and Roughing

The wires are first cut to length and straightened, if necessary, by rolling between blocks. The end of the wire is then filed or turned in a bench lathe, reducing the diameter preparatory to forming the handle, loop, or other special means of holding the wires (see Fig. 1). The bodies—that is, the gage diameters—are also rough-finished to within 0.001 or 0.002 inch of the required finished diameter. This amount, of course, depends wholly on the size of the wire, since the larger the wire the more metal may be removed in the lapping operation.

Hardening

The roughing operations having been completed, the wires are next hardened. They are held in the special device shown in Fig. 2, and heated in the air by an electric current passing through the wire, and are then hardened in oil. The wire *W* is held between the clamps *A* and the copper conductors *B* and B_1. The conductors are attached to, and are adjustable on the wooden insulator *C*, which is furnished with a handle. The side *D* of the supporting frame carries the copper circuit-breaker *G* at its extreme end, and is wired to the conductor *B* as shown. The frame is supported by the uprights *E* and is pivoted at *F*. The circuit-breaker *G* extends down into the copper vessel *H*, which contains mercury and from which one wire leads to the source of current. The other wire is attached to B_1, and with the measuring wire in position, as shown in the illustration, the course of the current will be obvious. The resistance caused by the wire *W* quickly and uniformly raises it to the desired temperature of about 1600 degrees F. The amount of current required for various sizes of wires, once determined, may be duplicated at will by means of the rheostat *R* which is connected in circuit with the generator. As soon as the proper heat is attained, the wires are quickly immersed in oil by swinging the frame downward by means of the handle. The levels of the mercury and of the hardening oil in their respective vessels are such that simultaneously with the wire entering the oil bath the copper circuit-breaker *G* is withdrawn from the mercury and the flow of current instantly stopped.

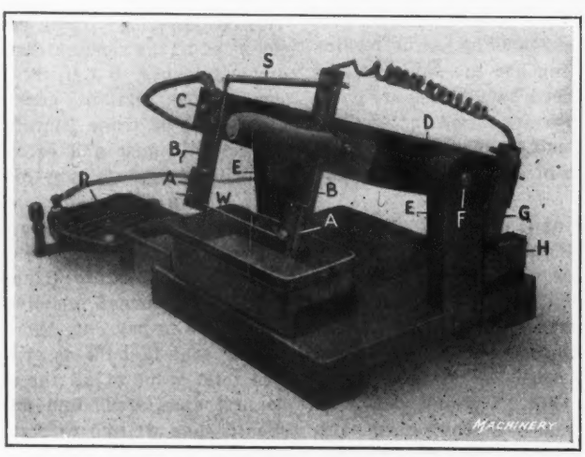


Fig. 2. Electric Hardening Device for uniformly hardening the Wires

It will be seen that by this arrangement no heat is lost through air exposure after the current has been broken, and the heated steel is not exposed to the air but for a moment; hence there is no opportunity afforded for oxidation of the steel. During heating, the metal expands slightly, and as a preventive against warping of the wires from this cause, the coil spring *S* is attached as shown and constantly exerts tension on the measuring wire, so that the increasing length is kept taut at all temperatures. This device entirely obviates a difficulty which will almost always occur with very small wires, such as those under 0.025 inch in diameter, for if special provision is not made, these small wires will bend and practically collapse when raised to a red heat and thus become set when quenched. By the use of this holding device, all wires both large and small come out of the hardening bath straight.

Tempering the Wires and Annealing the Ends

After hardening, it is necessary to relieve the structural stresses set up in the glass-hardened wires, by drawing to about 450 degrees F. or even less. The results ob-

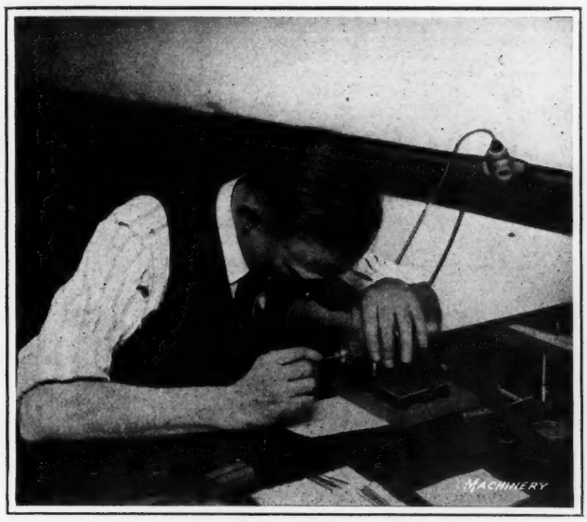


Fig. 3. Lapping and polishing

tained in the structure of steel by aging or seasoning are produced, according to Mr. Seaboldt, by a special process of heating which greatly reduces the amount of time required for seasoning. A wet cloth is next wound around the body of the wire, and the ends, which are not made to the gaging diameter, are annealed. The wet cloth prevents the heat from affecting the gaging diameter, confining it to that part of the wire which is later to be formed or drilled, as the case may be.

Lapping and Forming the Ends

The lapping operation, illustrated in Fig. 3, requires highly skilled work in order that a uniform diameter may be assured throughout the body of the wire. Cast-iron laps are used, and the best results have been obtained with an abrasive of either sixty-minute carborundum or aloxite. All microscopic blemishes are then removed with crocus and oil, and a highly polished surface is produced. The polishing is performed as a part of the lapping operation. The ends are next heated and formed into loops or handles, or else drilled as required, after which they are ready for inspection.

Inspecting

Fig. 4 shows the inspection bench at which each wire is carefully examined under a microscope for structural defects, and also tested for hardness, size, and straightness. An ordinary Prestwich fluid gage and standard Johansson gage-blocks are used for inspecting the uniformity and accuracy of diameter, which must be correct to within 0.00002 inch of the required diameter. The finished wires, after having passed inspection, are then placed in leather pocket cases, such as shown at *A*, Fig. 4, which contain compartments for the various styles or sizes. These cases are finally packed for shipment in small wooden boxes.

Material, Sizes, and Styles

Preferably Stubs steel wire is used in the manufacture of the wires, although in some instances drill rod has been found to answer the purpose satisfactorily. In general, the sizes of the finished wires range from 0.01 to 0.250 inch in diameter, although wires as small as 0.007 inch in diameter have been furnished. It will be noted by referring to Fig. 1 that the wires vary in size and style according to the specifications and may have either two plain ends as shown at *i*, or one end plain and the other end made in any of the various styles shown in the illustration. The larger wires are usually made with plain ends and are designed for use when making measurements on a measuring machine, while those having especially constructed ends may be hung on wires or rings for convenience in making micrometer measurements. The styles *a*, *b*, and *c*, however, being provided with both handles and holes for support, may be easily used in either way. The handles are made by flattening one end or by a two-piece construction, in which case the handle is made separately and afterward sweated onto the end of the wire.

Method of Determining Error in Thread Angle

As the three-wire system of thread measurement is well known, the only other data that may be of interest to the reader in this connection are the formula and accompanying table for determining the accuracy of the thread angle. The thread angle may be found by making two measurements, using two sizes of wires and measuring over them. The difference between these two measurements is divided by the difference between the diameters of the two wires used. By consulting the table, the angle which corresponds to this quotient may be determined directly. Thus, suppose the accuracy of a Whitworth thread were to be determined: Assuming the wires to be 0.120 inch and 0.073 inch diameter, respectively, and the two measurements over the wires to be 0.778 and 0.630 inch, then the two differences are 0.047 inch and 0.148 inch, and performing the division indicated in the formula $0.148 \div 0.047 = 3.1489$. Interpolating from the table, gives an angle of approximately 55 degrees, 27 minutes. While the most accurate method of obtaining the thread angle is by the use of three sizes of wires, satisfactory results can be obtained ordinarily with but two sizes of wires.

TABLE OF VALUES USED FOR DETERMINING ERROR IN THREAD ANGLE BY THE THREE-WIRE SYSTEM

D = difference between two measurements over wires;
d = difference between diameters of wires used.

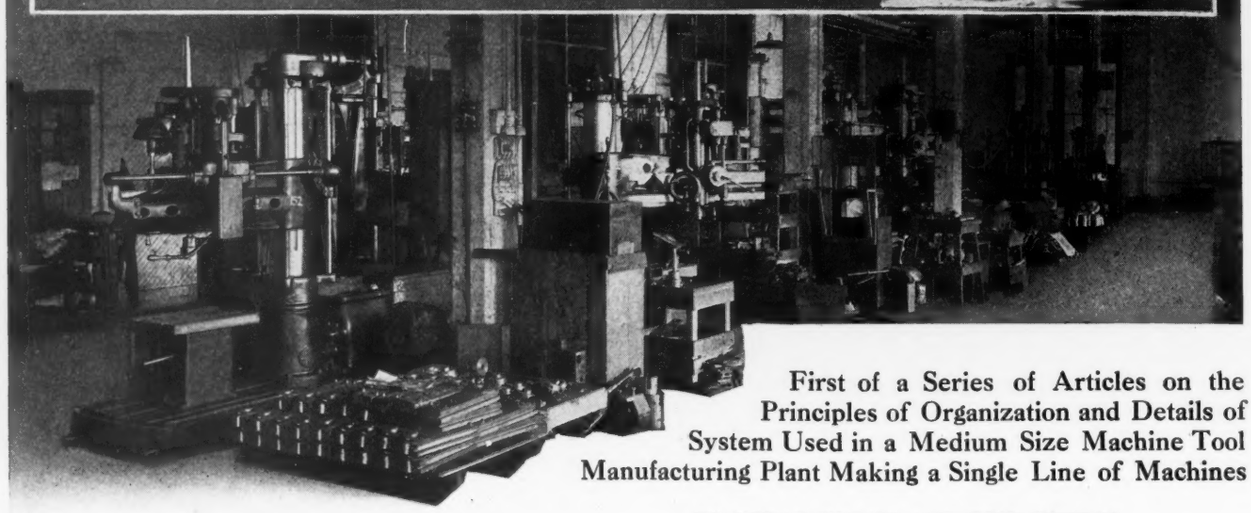
$$\frac{D}{d} = X$$

U. S. Standard Thread			Whitworth Thread		
X	Degrees	Minutes	X	Degrees	Minutes
3.0152	59	30	3.1840	54	30
3.0101	59	40	3.1778	54	40
3.0050	59	50	3.1717	54	50
3.0000	60		3.1657	55	
2.9950	60	10	3.1596	55	10
2.9900	60	20	3.1536	55	20
2.9850	60	30	3.1477	55	30

Machinery

Fig. 4. Inspecting the Uniformity and Accuracy of Diameter with Prestwich Fluid Gage and Johansson Gage-blocks. The Wires must be absolutely Accurate to within 0.00002 Inch of the Required Diameter

Organization and Management of a Machine Tool Plant



First of a Series of Articles on the Principles of Organization and Details of System Used in a Medium Size Machine Tool Manufacturing Plant Making a Single Line of Machines

BY OSKAR KYLIN[1] AND ERIK OBERG[2]

The importance of systematic management is becoming more and more recognized, and many machine tool plants are developing organizations and systems that are planned with a view to obtaining increased efficiency in production and greater economy in the machine shop processes. This series of articles is based upon the practice of the Foster Machine Co., Elkhart, Ind., in managing the engineering and production departments for the building of turret lathes.

THE principal functions of management, as the word is understood in its modern sense, are to plan the performance of certain work and to control the methods whereby the work is executed. The old-time or conventional type of management does not realize the necessity for thorough planning; what planning is done is haphazard in its nature and generally covers a brief period, and it is not thoroughgoing as to details. Modern methods of management require that the planning be complete and that it be done sufficiently far ahead so that all the factors involved in production can be adequately taken care of and assigned their proper place in the whole scheme of the organization. In a machine shop, this planning must include, in its broad scope, first the machines used in production, as well as all other equipment—standard and special—including all shop tools of every kind required for efficient manufacture; second, the machines or devices to be built; third, the buying of materials for the building of these machines (this should be done sufficiently far ahead to insure that the material is on hand when required, and at such times in the year as to take advantage of favorable prices or abundance of supply); fourth, the actual methods of production in the factory, which includes the determining, as far as possible in advance, the work to be done in every department and on every machine in each department. This planning having been adequately done, the functions of the management consist mainly of devising such a system as will insure that the plans are carried out according to schedule.

The importance of the planning department is evident to any student of management in as far as it relates to the production department, because the latter cannot show the best results unless the work is properly planned ahead; but many do not realize that it is equally important to plan the advertising and selling campaigns for a product in the same orderly manner, so that nothing is left to haphazard methods. When the planning is taken care of in this manner, the main efforts of the management are afterward centered in securing harmony and teamwork between the different departments, in order to obtain maximum efficiency. The management of the Foster Machine Co., Elkhart, Ind., has been organized and developed along the lines outlined, and it is the purpose of this article to explain the details of the methods by means of which the results required are accomplished, and to show that a simple system will meet the needs.

Five Principal Duties of Management

The duties of a modern manufacturing organization may be divided into five fairly distinct groups: (1) The planning of the manufacturing facilities and the product. (2) The securing of the help. (3) The actual production. (4) The selling. (5) The accounting. On this basis, the organization becomes divided into five principal departments: The engineering department; the employment department; the manufacturing department; the selling department; and the accounting department. There are a number of additional functions performed by the management, such as purchasing, inspection, shipping, etc., which may sometimes be placed under one of the five principal departments and sometimes under another, local conditions determining the best organization in this respect. Before describing the detail duties of each of these departments, a few general principles that have been accepted by the Foster Machine Co. as governing in the management of the organization should be referred to, for an understanding of these principles will make clearer the reason for the system of management applied to the plant.

Each Department must have Definite Authority

The authority of each of the five main departments as well as the subdivisions of these departments must be clearly defined. It is as necessary to have definite authority vested in each department head, if the greatest efficiency is to be obtained, as it is to have definite authority defined in the case of a military organization. No matter how excellent the designs, how up-to-date the equipment, how well thought out the tooling requirements, if there is no definite line of authority as regards the different departments there will be confusion—overlapping of the work done by different de-

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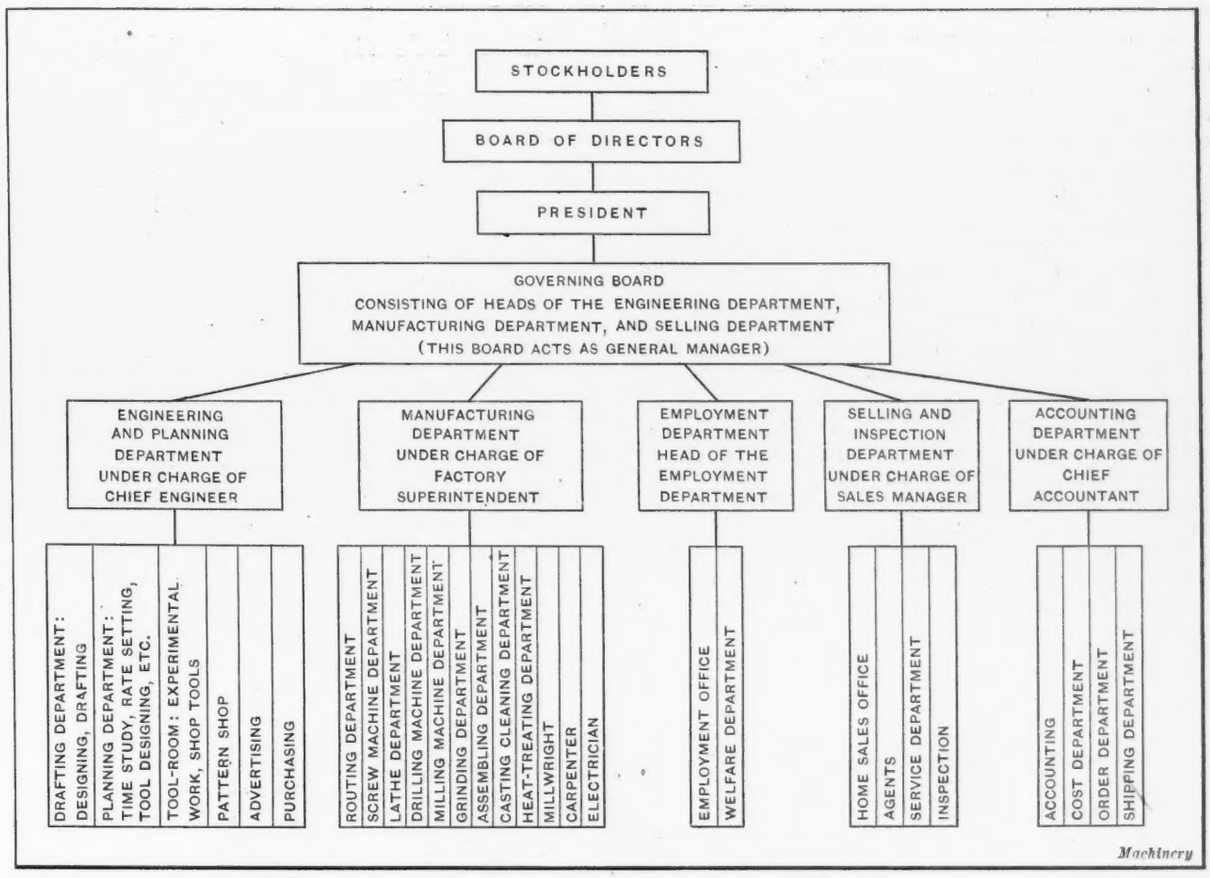


Fig. 1. Organization Chart of the Foster Machine Co., Elkhart, Ind.

partments and friction between departments and between individuals, all of which results in a loss of efficiency. Therefore, in determining upon a system of management, the first principle laid down should be that of preventing any interference between different spheres of authority. The extreme importance of this point should be as clearly recognized in industrial work as it has been in military affairs. This principle, however, relates only to the system itself, where it is vital that the line of authority is clearly established; but, in actual practice, it must be expected that the department heads have tact and diplomacy enough not to use their authority in such manner as to defeat the object for which this authority has been created, and great stress should be laid upon the fact that the authority is functional and not personal; that is, the authority is vested in the office and not in the person who occupies the office. Furthermore, all authority should be used only to see that the system as laid down is properly adhered to and the plans carried out. The authority of the management itself should be used only to see that functional cooperation between departments exists and to remove any obstacles that prevent this cooperation.

Cooperative Principle in Management

Another new principle in management, which is becoming more and more recognized and which doubtless has been one of the chief sources of the productive capacity of American machine shops, is that of cooperation between management and employes, which can best be defined as the democratic principle of management. During recent years, this principle has had a very direct and important influence on the systems and methods that have been adopted in managing large industrial undertakings. It has been recognized that the enthusiasm and energy of the individual may be utilized to the greatest extent for the benefit of the business and for the welfare of both the individual and of the entire organization. In order to obtain this cooperation of every individual, the management must recognize the fact that the greatest efficiency cannot be obtained in an enterprise that is run exclusively for the benefit of the stockholders, and that the best results can be obtained only when the men in the organization have a vital interest in its success; and this success can be achieved only when both the management and the employes recognize that they have a mutual interest in the development of the business. The management can do a great deal in creating the harmony required, but it can do so only by accepting the changed modern conditions in a broad-minded manner. It is recognized that to obtain the best efforts from every man, he must be encouraged by making his working conditions agreeable; congenial conditions and reasonable compensation are equally necessary to produce that sense of happiness in work without

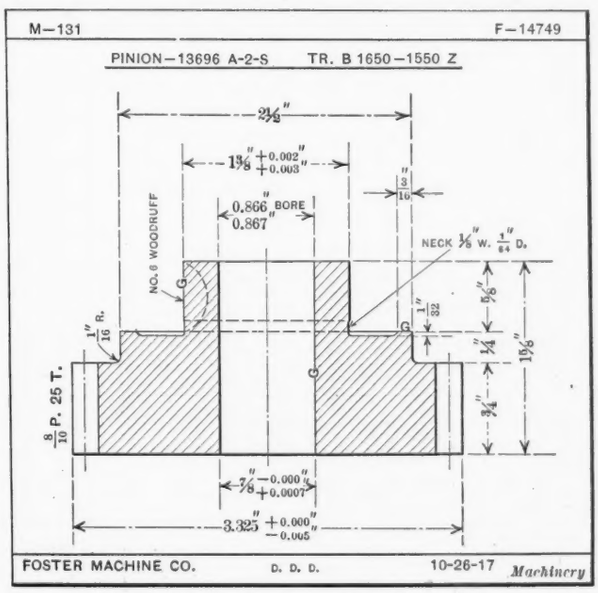


Fig. 2. Method of using Symbols and Limits on Drawings

which no one can do his best. When it is thoroughly recognized by the management that not only money compensation, but also the satisfaction that comes from harmonious conditions, is necessary to maintain an efficient working force, a great step toward increased efficiency will have been taken.

Application of the Cooperative Principle in Management

The application of the democratic principle in management is exemplified by the methods used in managing the Foster Machine Co.'s plant. This plant is managed or governed by a board which is headed by the president as chairman, and which consists of the heads of the engineering department, the manufacturing department, and the selling department. This board of three executives acts as general manager of the plant and has full authority to carry out the policies of the company in the absence of the president. Hence, even a prolonged absence of the president will not interfere with the working of the organization.

The general managing board, in turn, is assisted by an advisory board consisting of the foremen, who have meetings at which questions relating to the various departments are brought up. The foremen are given to understand that they are part of the management; that the ideas that they present are of importance in the developing of the plant to its highest efficiency; and that their suggestions are carefully considered. The foremen meet once a week, and the cooperation thus obtained has proved very valuable. In addition to this general managing board and advisory board, each department chief also selects, among the heads of the departments under him, a board of advisors, so that, in this way, every man in the organization may be made to feel that he cooperates toward one common end, and that his opinion can be made to count.

In addition to the cooperation obtained in this manner, it is also aimed to obtain the utmost cooperation between departments. The planning department, for example, obtains advice from the foremen, and the latter are made to understand that they are actually an advisory part of the planning department. The foremen are also advisory to the inspection department and recognize that it is their duty to insure that no unsatisfactory work passes out of their department.

M-162 Single Cutter Turner. For No. 3 S.M. JOB NO.— NO. M'CH'S— E-13095

NO. OF PCS. ON MCH.	NO. OF PCS. ON UNIT	NAME	PART NO.	B. P. NO.	MATERIAL	DIAM.	LENGTH	STOCK	REMARKS
	2	Screws	4399A	4399A	A-1-S	7/16 Hex.	1 7/8		
	1	Screw	12335	F-12322	D-2-S	5/8	1 5/8		
	2	Screws	12376	F-12403	A-1-S	13/16	2 7/8		
	2	Studs	13605	F-14368	A-6-S	9/16	1 5/32		
	1	Screw	12397	F-12418	A-1-S	3/4	1 1/16		
	1	Screw	12401	F-12422	A-1-S	7/8	1 1/16		
	1	Screw	12405	F-12430	A-1-S	5/8	1 5/8		
	1	Screw	12917	F-13086	A-1-S	1 1/4	2 1/4		
	2	Roll Jaws	P12918	F-13087	M.I.				
	2	Rolls	12919	F-13088	A-6-S	1 1/16	5/8		
	1	Spring	12921	F-13089	#30M.				
	1	Handle	P12922	F-13090	M.I.				
	1	Screw	12923	F-13091	A-2-S	15/16	4 5/8		
	2	Plugs	12924	F-13092	A-1-S	5/8	7/8		
	1	Slide	P12925	E-13093	M.I.				
	1	Washer	12926	F-13094	A-1-S	1	7/4		Machinery

Fig. 3. Part List, giving All the Parts that are to be made for Each Unit of a Machine

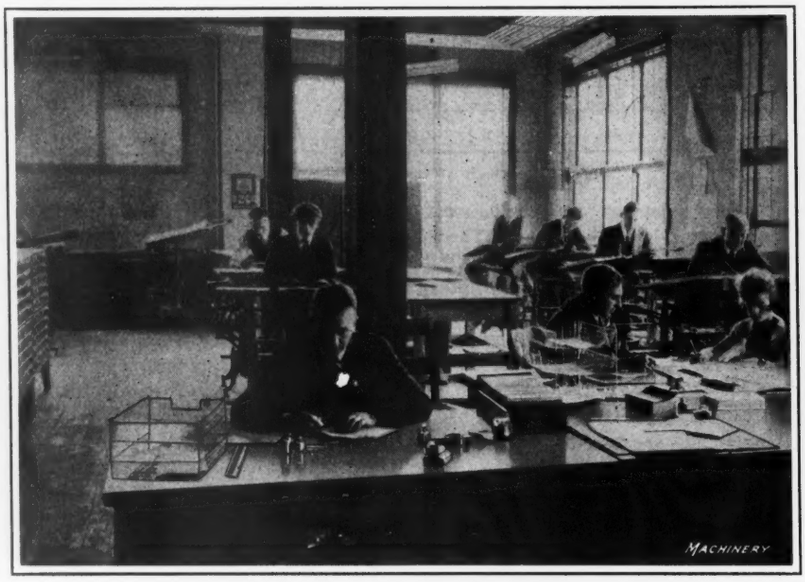


Fig. 4. General View in the Planning Department

Duties of the Managing Board

The general organization of the Foster Machine Co. is shown in Fig. 1, from which it will be seen that the organization is headed by the president, and that the governing board, consisting of the heads of the engineering, manufacturing, and selling departments, acts as a general manager. Under this board, five separate departments are organized, as previously referred to, and, under each of these departments, are sub-departments.

The duties of the governing board are exactly the same as those of a general manager. The board meets every other day, at 9 o'clock in the morning, for a conference, which may last from a half hour to two or three hours, according to the importance of the questions taken up. Special meetings may be called by any of the members of the board to discuss questions that require immediate attention. At these meetings, general policies are determined, and reports are presented, making it possible for the board to supervise the work of the plant properly. In addition, the principal questions in planning for the future are taken up, and the following matters are disposed of: The hiring of men for more important positions, such as foremen and other sub-department heads; the salary increases of sub-department heads; production schedules, the method of making

Cross-slide and Carriage for No. 1-B Univ. Turret Lathe M-131 LOT NO.— NO M'CH'S— E-13007

NO. OF PCS. ON UNIT	NAME	STYLE	DIAM.	LENGTH	USED ON PART NO.	REMARKS
2	Nuts Fin.	Hex. Check	1/2	5/16	12641	Left-hand Thread
1	Bowen Oiler	2-C	3/8	1/2	12635	
1	Taper Pin	No. 4	1/4	2	12649	
1	Ball	Steel	5/16		12651	
1	Woodruff Key	No. 9			12634	
2	Nuts Fin.	Hex. Check	5/8	5/16	12634	
5	Bowen Oilers	2-C	3/8	1/2	P12630	
1	Nut Fin.	Hex. Check	3/16	5/16	12616	
2	Bowen Oilers	4-C	1/2	1/2	P. 12631	
						Machinery

Fig. 5. Stock List, giving All Parts kept in Stock for Each Unit of a Machine

JOB NO. [redacted]
NO. ROUTED [redacted]
NO. NEEDED [redacted]
TO BE FIN. [redacted]

ROUTING CARD
FOSTER MACHINE COMPANY

PART NO. 12623
NAME Shaft
UNIT Head and Bed
MAT. A3S TRAC. NO. E-12502 MACH. NO. [redacted]

OPER. NO.	NAME	DESCRIPTION	SET UP TIME	STD. PRO. TIME	RECORD TIME
1	1-B S. M.	Turn, center, neck and cut off-Gage	1hr 30m	10.12m	
2	1-B S. M.	Face and center other end #12623-A	30m	2.25m	
3	Mill. Mch.	Mill Keyway	15m	4.5m	4m
4	Drill. Mch.	Drill Holes	10m	1.55m	1.5m
5	Grnd. Dept.	Grind	20m	14.5m	13.7m
6	Inspect. Dept.				
7	Stock Room				

Fig. 6. Routing Card on which Operations for Each Piece are recorded

up of which will be explained later; what machines should be designed and what machines should be especially pushed by the sales department; general policies regarding advertising and publicity; purchasing; wages in the shop; methods of wage payment; adjustment of any difference between departments or between the men and the firm; general sales policies; and the analyzing of cost and production reports.

As planning is considered to be one of the most important functions of the management of the plant, the organization of which is described, it may be well to point out that the systematic planning is not left to the planning department proper, but begins with the governing board, and that an effort is made to permeate the whole organization with the idea of the importance of planning ahead. There is a distinction between planning and scheduling. Planning takes care of everything except the time element; scheduling takes the time element into account. For example, planning would involve making provisions for the production of a certain number of machines in a certain way. Scheduling then takes care of producing these machines in a given time. It may be said that scheduling gives the planning a concrete form. All work within an organization should be carried out according to a time schedule. This does not relate only to the production work, but to the engineering work and the designing as well. In this way, each department may be made to understand that it is expected to produce results in a given time. By planning and scheduling, results have been obtained in this organization that were formerly not thought possible.

Engineering Department

The engineering department is under the charge of a division manager who also acts as the chief engineer. The duties of this department are to design, experiment with, and develop the product that is to be made in the plant, carrying it forward to such a point that it may be manufactured in quantities. In addition, this department plans the manufacturing operations and determines production time and piece rates. It also handles the advertising and the purchasing of materials used in the shop in the manufacture of the product, and, in addition, has charge of the tool-room and pattern shop. Hence, it is divided into six subsidiary departments as follows: Drafting-room, planning room, tool-room, pattern shop, advertising, and purchasing.

Drafting-room

The drafting-room is under the charge of a chief draftsman, directly responsible to the chief engineer. The duties of the drafting-room are to design new machines, to prepare and keep records of all drawings, to prepare blueprints for the shop, and to keep records of these prints. The drafting-room also makes production studies of work for customers using the Foster screw machines and turret lathes, and the experts on the use of these machines are placed in this department, so that they may prepare tooling lay-outs and time studies for outside work. The so-called "setting-up" diagrams are prepared in the drafting-room in cooperation with the selling department. This cooperation is one of the examples of the fundamental inter-relation that exists between the various departments, although the authority and work of each department is clearly defined. The drafting-room is also the information bureau for all outside inquiries relating to work to be produced on the company's machines, and it has immediate charge of everything pertaining to the machines being built, such as the limits of accuracy, materials, finish required, etc.

Fig. 7. View of that Part of the Tool-room where the Jigs and Fixtures are made

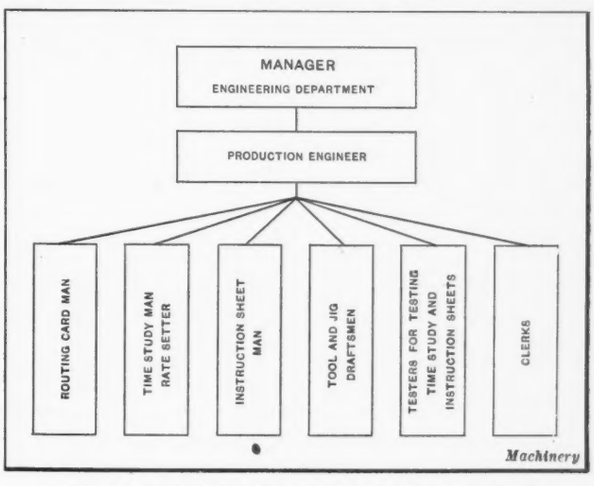


Fig. 8. Organization Chart of the Planning Department

MATERIALS USED AND SYMBOLS BY WHICH THEY ARE DENOTED

List of Materials

CAST IRON

Material and Symbol	Make	Graphite	Carbon	Manganese	Phosphorus	Sulphur	Silicon		Remarks	Paint Color on Bars
No. 1 C.I.		2.00–3.00	0.50–0.60	0.55–0.65	0.4–0.475	0.075	2.00–3.00		Ordinary Cast Iron	
No. 3 C.I.									Semi-Steel Cast Iron	
No. 1 Mall.									Ordinary Malleable Iron	
No. 2 Mall.									Semi-Steel Malleable Iron	

BRASSES AND BRONZES

		Copper	Tin	Lead	Zinc	Phosphorus	Antimony			
No. 1 Brass		70.00	5.00		25.00				Yellow Brass Casting	
No. 2 Brass		85.00	5.00	5.00	5.00				Red Brass Casting (High Grade)	
No. 3 Brass		81.00	1.00	7.00	11.00				Red Brass Casting (2nd Grade)	
No. 4 Brass									Yellow Drawn Brass Rod	
No. 5 Brass									Red Drawn Brass Rod	
No. 10 Bronze		90.00	9.00	1.00		0.50			Hard Bronze	
No. 14 Bronze		80.00	10.00	10.00		0.50			Bearing Metal	
No. 1 Babbitt		4.5	89.00	0.50			6.00		Spindle Bearings	
No. 1 Aluminum									Aluminum Casting	

STEELS

		Carbon	Manganese	Phosphorus	Sulphur	Silicon	Nickel	Chromium		
A-1-S.	Bessemer or Open-Hearth	0.08–0.16	0.60–0.80	0.09–0.13	0.07–0.15				Cold-Drawn Steel	Black
A-2-S.	Open-Hearth	0.13–0.23	0.30–0.50	0.04	0.04	0.20			For Carburizing	Green
A-3-S.	Open-Hearth	0.30–0.40	0.60–0.80	0.04	0.04	0.20			Machine Steel	White
A-4-S.	Open-Hearth	0.45–0.55	0.60–0.80	0.04	0.05	0.20			Spindle Steel	White and Brown
A-5-S.	Crucible	0.70–0.80	0.25–0.45	0.03	0.03	0.20			Collet Steel	Yellow
A-6-S.	Crucible	0.95–1.10	0.25–0.45	0.03	0.03	0.20			Common Tool Steel	Red
A-7-S.	Crucible	0.60–0.70	0.25–0.45	0.03	0.03	0.20			Set-Screw Steel	
A-8-S.									Steel Tubing	
A-9-S.	Open-Hearth	0.35–0.45	0.60–0.80	0.03	0.05	0.20			Ground Shafting	
B-1-S.	Crucible								Drill Rod	
B-2-S.	Crucible	0.85–0.95	0.25–0.35	0.02	0.02	0.15			For Punches, Chisels, etc.	
B-3-S.	Crucible	1.15–1.30	0.25–0.35	0.015	0.015	0.12			Taps, Drills, Cutters, etc.	Blue
B-4-S.	Crucible								For Brass and Finishing Cutters	Olive
B-5-S.	Crucible								Oil-Hardening Alloy Tool Steel	Gray
C-1-S.	Open-Hearth	0.10–0.20	0.30–1.00	0.04	0.04	0.20	3.25–3.75		For Carburizing	Green and White
D-2-S.	Open-Hearth	0.35–0.40	0.50–0.70	0.04	0.04	0.20	1.00–1.25	0.25–0.50	Treated Shafts, Set-Screws, etc.	Brown
D-3-S.	Open-Hearth	0.40–0.45	0.50–0.70	0.04	0.04	0.20	1.00–1.50	0.50–0.75	Treated Shafts, Gears, Pinions, etc.	Red and Yellow
D-4-S.	Open-Hearth	0.45–0.55	0.40–0.60	0.03	0.03	0.20	1.45–1.75	0.90–1.25	Oil-Hardening for Gears	Red and Blue

Machinery

The drafting-room system, the methods of indexing drawings, etc., are about the same as in the majority of well-conducted machine tool shop drafting-rooms. Separate drawings are made for each piece, an example of such a drawing being shown in Fig. 2. The number in the upper left-hand corner is the machine number and that in the upper right-hand corner, the drawing number. The number immediately following the name of the piece—on this drawing, 13,696—is the piece number, while the symbol "A-2-S" designates the material used—in this case, open-hearth steel with a carbon content varying from 0.13 to 0.23 per cent. A list of the materials used, together with the symbols employed, is given in the accompanying table. The notation "Tr. B1650-1550Z" in Fig. 2 indicates the heat-treatment, and a special chart is also provided giving the key for these treatments. In this case, the symbol indicates that the pinion is to be case-hardened by being heated to 1650 degrees F. for carburization and then reheated to 1550 degrees F. and quenched.

It will be noted by reference to the drawing that all important dimensions—that is, dimensions for which some kind of fit is required—are provided with tolerance. In all instances where tolerances are not given on the drawing, it is understood, in the case of machined surfaces that the tolerance is ± 0.010 inch.

JIGS, FIXTURES, ETC., NAME Stop PART NO. P12588
TRAC. NO. E-12216

DESCRIPTION	JIG NO.	TRAC. NO.
Drill Jig, 1st Operation	12588 A	C-13015
Milling Fixture for Milling Slot	12588 B	C-13027
Gage for width of Slot	12588 C	C-13027

Machinery

Fig. 9. Jig and Fixture Record kept by the Planning Department

the general capacity of the machine to be made. The chief engineer then works out the general features, the principal dimensions, and the new ideas to be incorporated in the design. The work of the chief engineer consists, strictly speaking, in planning the design. He turns over to the designer the plans in the form of free-hand sketches with tables of important dimensions, and the designer then proceeds to make up a preliminary design of the machine. This is made on drawing paper, fairly well in detail. The design is made by units, every unit being drawn full size.

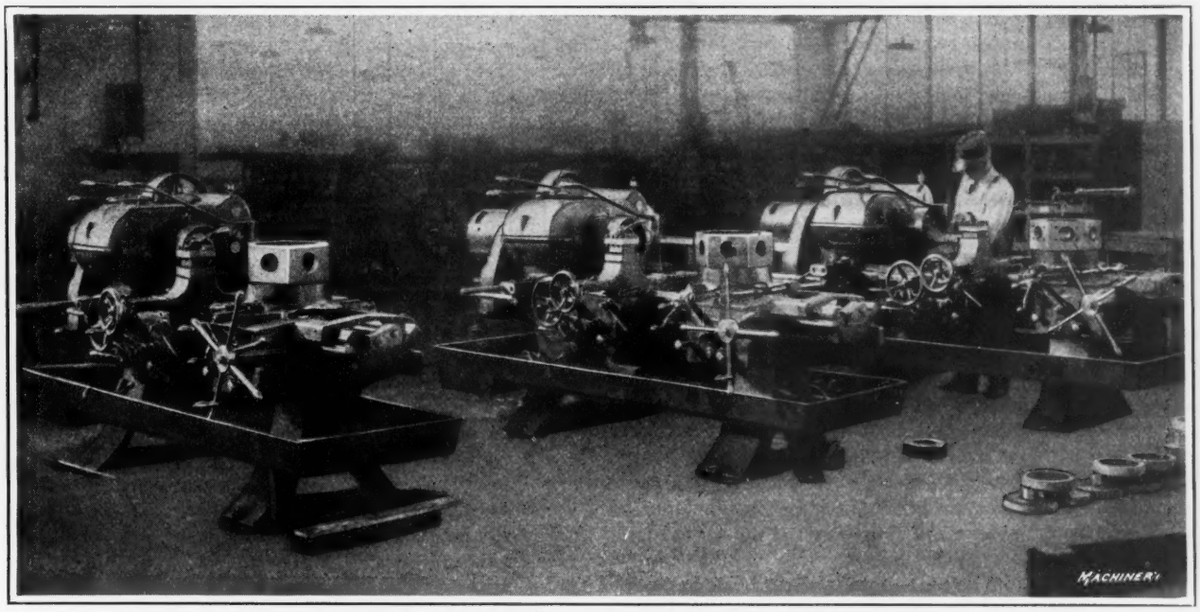


Fig. 10. View of that Part of the Tool-room where Experimental Machines are built

Details of Methods Used in Designing New Machines

When the design of a new machine has been decided upon by the managing board, the board designates the type and

JIGS, FIXTURES, ETC., FOR PART NO. P12588

DESCRIPTION	JIG NO.	RACK	SHELF
Drill Jig, 1st Operation	12588A	D	18
Milling Fixture for Milling Slot	12588B	E	18
Gage for Width of Slot	12588C	E	18

THIS CARD BELONGS IN TOOL STORAGE

Machinery

Fig. 11. Jig and Fixture Record kept by the Tool Storage Room

After the unit designs have been worked out as described, the next step is to make a full-size assembly drawing of the whole design on large sheets of paper, showing the outside appearance. This design is now brought before the managing board for discussion, the advantage of a full-size lay-out being that it makes it possible to see just how the machine will look when completed. It will indicate accurately the location of levers and handwheels and show the operating conditions. The board goes over the design with a view to seeing that it involves all the features of ease of operation, convenience of control, and rapidity of action that will be required. After such changes as may be decided upon by the board have been made, the actual or final unit designs are made in the form of construction drawings. These are made in pencil on heavy drawing paper, giving completely every detail and showing the part number of every part, as well

as the symbols for the material, the heat-treatment, and all other special information needed by the detailer. These construction drawings are checked and approved by the chief engineer and then passed to the detailer, who makes the individual detail drawings, by tracing most of the parts directly from the full-scale construction drawings.

In numbering the parts on the drawings, the Foster Machine Co.'s system is to number all parts consecutively, and those that are cast—that is, those provided with patterns—have their number preceded by the letter "P." As new machines are designed, the piece numbers follow consecutively. It has been found most convenient to use this system, because some parts may be used on a number of machines, and in that case it is a disadvantage to have the number of the piece include a machine symbol which would tie it to one particular machine. Each individual type of machine, however, has a machine number, as shown in the upper left-hand corner of Fig. 2. This number includes all parts of the machine that are necessary to produce it complete, but does not include tools or attachments. All standard tools or attachments have separate machine numbers.

Part and Stock Lists

After the parts of the machine have been detailed, a part list Fig. 3, is prepared, all parts for each unit of a machine being listed separately. This list gives, in consecutive columns, the total number required of each part for one machine (given only in case the same part is also used on other units of the same machine); the number required in the unit for which the list is prepared; the name of the piece; the part number; the blueprint number; the material (using the symbols indicated in the key list table); and the diameter and length of stock required. The part list includes such parts as are especially made for each machine. A stock list, as shown in Fig. 5, is also prepared of all parts used for each unit, when these parts are kept in stock. The lists are numbered the same as drawings, and are filed and recorded in the same way. Black spaces are left on the tracings (which will print white on the blueprints) for filling in "Lot No." and "No. of Machines," the latter figure referring to the number of machines in a lot.

The part and stock lists are a complete record of all parts required for building one unit. They are used first by the purchasing department for ordering all the necessary materials for a given lot of machines, and later by the routing department for ordering the manufacture of the parts called for by the lists. Later, these lists are also used by the assembling department for requisitioning parts from the store-room, as all parts that are either manufactured or on the stock list pass to the store-room before being delivered to the assembling floor. Finally, the lists are used by the cost department when determining the cost of each unit. In addition, they are used by the planning department in determining upon methods and time and piece rates.

The Building of Experimental Machines

When a new machine has been designed, an experimental machine is built in the tool-room and tested under the supervision of the chief engineer. The tool-room is under the authority of the engineering department instead of under the production department, because the tool-room is a part of the mechanism required in the development of machines to be built and constitutes one link in the preliminary work. The production department has been so organized as to have nothing to do with planning the production, the intention being to have it devote all of its energies to manufacturing problems. The experimental machine is thoroughly tested by being given a trial run in the tool-room on actual productive work for a period of from two to three months. Having passed this test, it is placed in the manufacturing department as a part of the regular equipment, and tested on actual production work for several months. Changes required in the design and in the patterns are then made and the machine is finally approved by the managing board. This board then estimates the probable yearly production of new machines, and determines from this estimate the approximate expense permissible in producing tool equipment. When the expense for tools and fixtures has been determined, this equipment is designed by the planning department.

Organization and Duties of the Planning Department

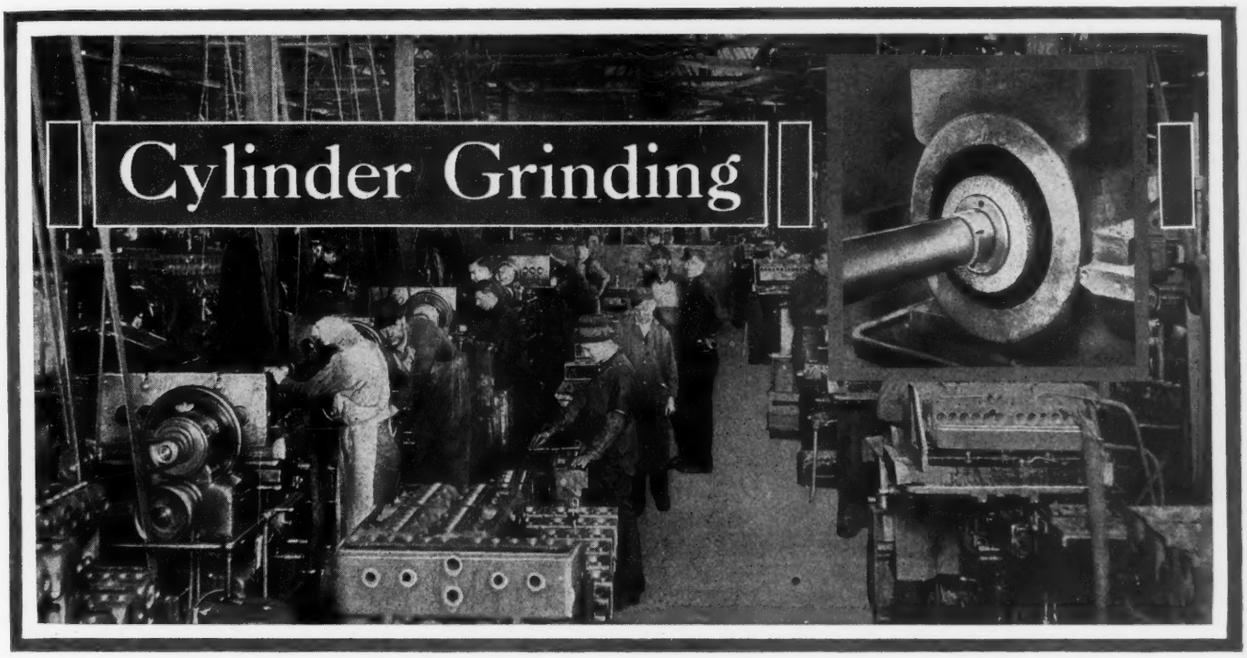
Fig. 8 shows an organization chart of the planning department which is under the charge of a production engineer. Fig. 4 shows a general view in this department. The duties of the planning department may be briefly stated as follows: It plans the methods of production; it designs the tools, jigs, and fixtures required; it establishes production time standards; and it sets piece-work rates. When requested to produce designs for jigs and fixtures for a new machine, the production engineer first makes a preliminary study of the requirements and the production methods, and, after having made such a general survey, he lays out the work for the different men responsible to him and prepares a schedule time for the design and building of the jigs and fixtures.

The duties of the planning department in connection with a new machine begin with those of the routing card man, who makes a detailed study of each part and determines what operations must be performed on each. He determines definitely the methods to be used, the machines on which the work is to be done, the department where the work is to be performed, and, finally, makes out a routing card for each piece, containing this information. This routing card is shown in Fig. 6. On this routing card, the planning department fills in the part number, the part name, the material, the tracing number on which the piece is shown, the operation numbers, the departments where the work is to be done, a brief description of the actual operation with the number of the jig, fixture, or gage employed, as well as the number of the instruction sheet, if one is available, the set-up time, and the standard production time. The last column of the routing card, giving the record time, is filled in later, giving the fastest time in which the part has ever been produced. The blanks for the routing cards are printed on tracing paper, and the routing card man fills in this original tracing, which is provided with black spaces for job number and other information which would vary each time the same parts were passing through the shop. Blueprints are made from these routing cards and the white spaces produced on the blueprint are then filled in for each individual case.

The routing cards now go to the tool designer as a guidance in the design of the jigs and fixtures for such operations as will require special tools. In the design of jigs and fixtures, care is always taken not to carry the tool design too far. The actual saving produced by the use of a fixture is figured out in advance to see whether it is worth while making the fixture. Sometimes fixtures are required in order to produce interchangeability, but, as a rule, they are used for reducing the cost of production.

When the drawings of the jigs and fixtures have been made, they pass to the tool-room, Fig. 7, where these devices are made. When completed, they are tested by actually building three machines in the tool-room from the new jigs and fixtures. Should it become evident during the making or assembly of these three machines that changes are required in the jigs or fixtures, these changes will be made, and then the jigs, fixtures, and gages are ready for the manufacturing department. By following the method of building three preliminary machines from the jigs and fixtures, there is an assurance that the tools are right, and the danger of putting through a lot of, say, fifty machines with incorrect equipment is eliminated. Fig. 10 shows three "test" machines on the floor of the tool-room. The planning department keeps a record of the jigs and fixtures and the tracings from which they are made, as indicated from the card in Fig. 9. The tool storage room keeps a record of the same jigs and fixtures, as indicated by the card in Fig. 11. By having the racks and shelves marked with letters and numbers, as indicated, it is possible to locate the required fixture quickly.

Cylinder Grinding



First of Two Articles on Advantages of Finishing Cylinder Bores by Grinding; Machines and Auxiliary Equipment Used; and Practice in Different Plants Manufacturing Engines for Automobiles and Airplanes

BY FRANKLIN D. JONES

THE grinding of engine cylinder bores in order to obtain a smooth accurate cylindrical surface is ordinarily confined to cylinders of internal combustion engines, because an accurate bore and a close-fitting piston are essential for motors of this class. The same degree of finish and accuracy is not necessary for the cylinders of steam engines, pumps, air compressors, and similar equipment, so the grinding process is not applied to work of this class except in a few special cases. The machines designed exclusively for cylinder grinding are used principally in the manufacture of engines for automobiles and airplanes (although they are often employed on other classes of work), and for this reason the practice to be described pertains almost exclusively to engines of the types mentioned.

The two general methods of finishing cylinders that have been adopted by different automobile manufacturers are, first, boring and grinding, or boring, reaming, and grinding, and, second, boring and reaming, the reamer in the latter case being used for finishing, except when it is followed by a lapping operation. Whether or not cylinders can be finished more economically by the grinding or the reaming methods may depend upon the design or type of cylinder, the class of service for which the motor is intended, as well as the care and intelligence exercised in the selection and use of the necessary tools and machines.

Grinding vs. Reaming in the Automobile Industry

In the automobile field, most manufacturers finish cylinder bores by grinding. In order to determine in a general way to what extent grinding has been adopted in preference to reaming, the practice of thirty representative manufacturers was ascertained, including the manufacturers of cars ranging in price from the cheap to the expensive grades. Twenty of these concerns finish cylinders by grinding, and ten by reaming. Various reasons are given for the adoption of one method in preference to the other. Many contend that grinding is the only practicable method of securing the required degree of accuracy, but others believe that reaming is not only more rapid than grinding, but is just as accurate, assuming in each case that the tools are properly constructed and applied. These differences of opinion are undoubtedly due in part to the variable conditions which exist either as regards the tools used or the nature of the work. For instance, the results obtained by reaming may depend upon the design of the cylinder, the thickness of its walls, the uniformity of different castings as to hardness, and the design and condition of the tool equipment. One reamer may cut smoothly and finish a cylinder bore within close limits of the required diameter, whereas another reamer, possibly of the same type, will chatter and leave a poorly finished hole. Frequently, such variations in the quality of the work are due entirely to the method of sharpening the reamers. The same line of reasoning applies to grinding, one manufacturer following approved practice in the selection of grinding wheels, or in properly machining the cylinders before grinding, and another not using the cylinder grinder to the best advantage.

Common Objections to Reaming Method and Advantages of Grinding

The difficulties that seem to be the most prevalent in connection with the reaming of cylinders and the objections usually cited by manufacturers who have adopted the grinding method may be summarized as follows: (1) The springing of the cylinder walls under the pressure of a cut, especially if the walls are comparatively thin; (2) hard or soft spots in the cylinder which cause the reamer to be deflected; (3) open ports in the cylinder wall (in the case of two-cycle engine cylinders) which interfere with the reaming operation; (4) the difficulty of keeping reamers sharp and cutting to the exact size required, especially when operating on the hard dense castings which are desirable for engines of the best quality; (5) the loss of compression and power in a reamed cylinder until it is worn in by running the engine. Just how important these objections are depends on conditions. For instance, the springing of the cylinder under the pressure of the cut may be very pronounced in the case of a light cylinder having a thin wall, but of no account as applied to a heavy cylinder casting. The second difficulty mentioned, arising from hard or soft spots in castings, may be due to poor foundry practice, especially if this lack of uniformity is the rule rather than the exception. While errors which may be traced directly to the tool itself show that some one reamer or type of reamer is not suitable, it does not follow that good work cannot be obtained by the

reaming method. If the relative merits, however, of the reaming and grinding methods are to be based on actual practice, the conclusion is that grinding is considered preferable by most manufacturers, especially for motors of the best class (such as are used in automobiles and airplanes), which must withstand severe duty; reaming is employed more generally in manufacturing the cheaper grades of gas and gasoline engines of the kind used for various industrial purposes. The reaming method is more rapid than grinding, but the difference in this respect depends somewhat upon the time required to keep the reamers in good condition and the degree of accuracy that is considered necessary. When cylinders are finished by grinding, there is no difficulty due to springing of the cylinder wall, because the pressure of the cut is very light if the proper grade of wheel is used, and the accuracy is not appreciably affected by hard or soft spots or by the side ports of two-cycle engine cylinders.

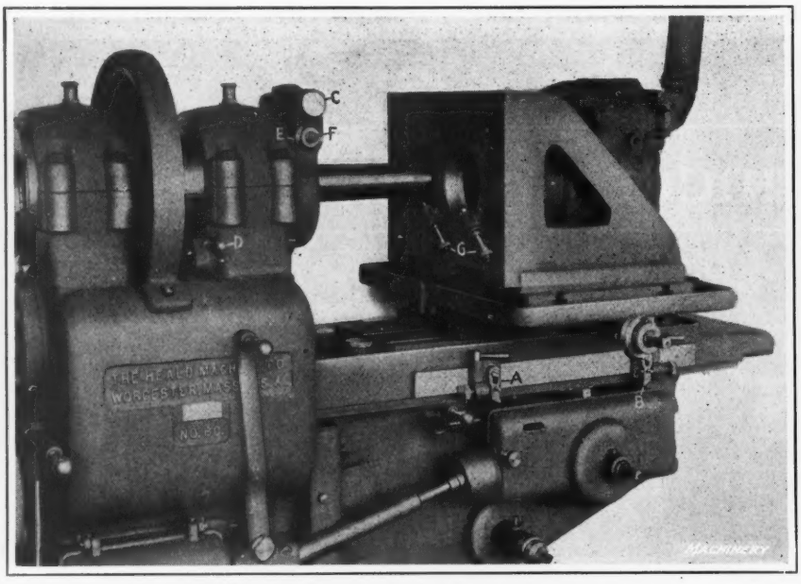


Fig. 1. Heald Cylinder Grinder grinding a Two-en-bloc Casting

Reasons why Some Manufacturers Grind Cylinders and Others Ream Them

A few of the reasons given by representative automobile manufacturers for preferring either the grinding or reaming method will be given in order to illustrate to what extent opinions differ:

"All cylinder bores are finished by boring and grinding. We tried very hard to get the desired results by reaming, but have discarded this method and believe that boring and grinding is the only practicable way of finishing cylinder bores within the desired limits of accuracy in quantity production. A cylinder may be reamed satisfactorily if the reamer is sharp and properly applied, but when the cutting edges are a trifle dull and the reamer is forced a little, good results are not obtained, as the cylinders will be oversize, tapered, and out of round. The finish obtained by reaming is not smooth enough, and soon after the motor is in operation the surface will wear down, thus increasing the cylinder diameter and the clearance between the cylinder wall and piston sufficiently to cause trouble. The cylinders finished by grinding are held within limits of 0.0005 inch plus or minus, and they are straight and round within an error of 0.0005 inch. We have been unable to obtain such accuracy by reaming, the reamed cylinders in many cases being as much as 0.004 or 0.005 inch out of round and tapered. If the reamed cylinder is checked by accurate measurement at the top and bottom flanges, it is fairly round, but in between the flanges where the cylinder wall is unsupported and in many cases a little thinner due to shifted cores, the cylinder wall will spring away from the reamer which does not produce a perfectly round or straight bore."

"At the present time, all standard cylinders are finished by reaming. The bores can be reamed within 0.00025 inch of being straight and round, which is better than we could do by grinding. The reaming method also increases production in the ratio of 4 to 1. A single-spindle machine is used for the final reaming operation. Attempts have been made to finish-ream on a multiple-spindle machine, but as yet the results have been unsatisfactory. An eight-blade left-hand spiral floating reamer is used for finishing."

"While a properly reamed cylinder will give fully as good service as a ground one, we have adopted the grinding method. The principal trouble with reaming is the difficulty in obtaining reamers that will hold their size and produce a uniform smooth finish. It is on account of the upkeep of reamers that the grinding method of finishing cylinder bores is preferred."

"We have had considerable experience with both reamed and ground cylinders, and have found that the ground cylinder proves to be the best not only from a quality standard, but also from an economical viewpoint, taking into consideration the extra amount of work that must be expended in the test room in order to produce a first-class job."

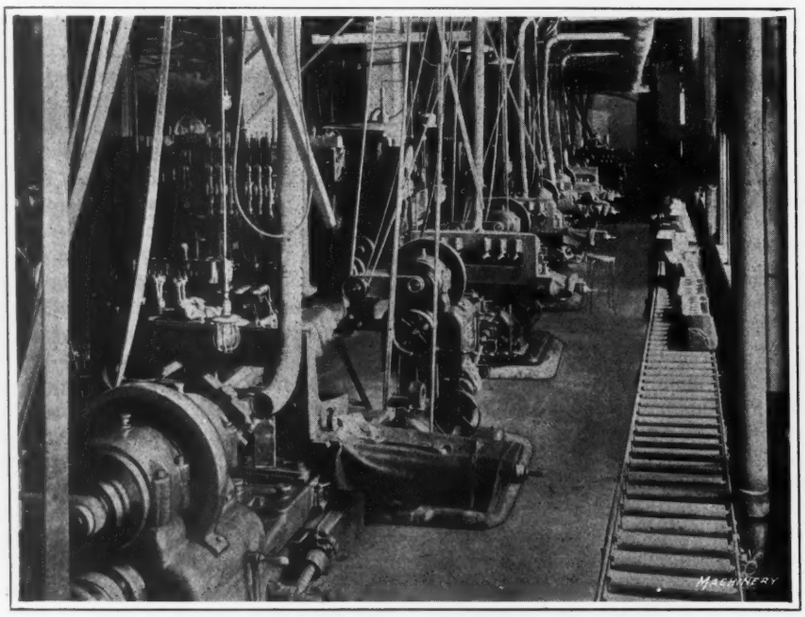


Fig. 2. Battery of Cylinder Grinders in Packard Plant

"The cylinders of engines for passenger cars are finished by boring and grinding, and truck engine cylinders by boring and reaming."

"Cylinder bores are finished by boring and reaming. This method has given good results and as many as three hundred cylinders have been finished before changing reamers. The reamer is a six-blade left-hand spiral type secured to a floating bar. It produces a smooth straight hole and cuts without vibration or chatter."

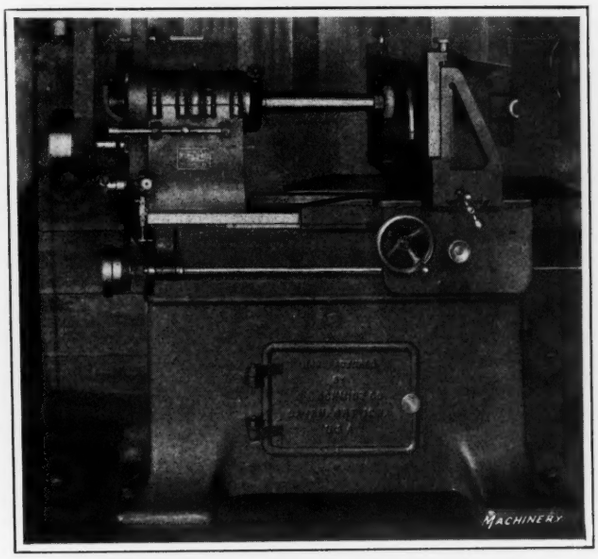


Fig. 3. Schmidt Cylinder Grinder with Work in Position for grinding

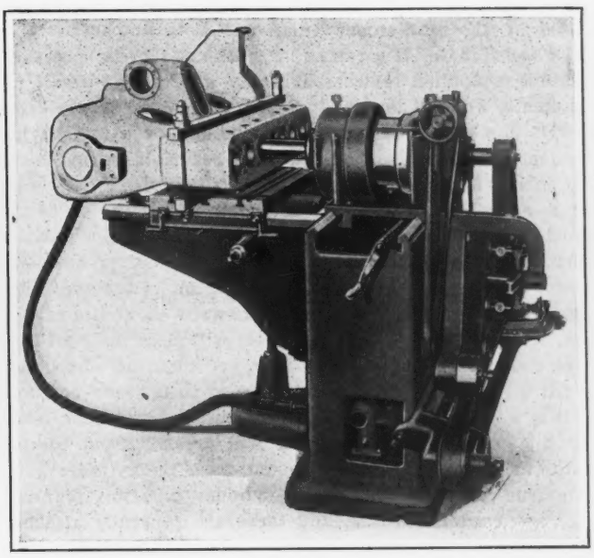


Fig. 4. Madison Cylinder Grinder operating on a Six-en-bloc Casting

"Our entire output consists of tractor motors, and we consider that the reamed cylinder is satisfactory for this class of service. A four-blade roughing reamer is used, followed by an eight-blade finishing reamer."

Planetary or Eccentric-head Type of Cylinder Grinder

The common practice of forming two or more cylinder bores in one solid casting or en bloc makes it desirable to devise a method of grinding cylinders without revolving them on account of the difficulty of rotating a large casting and of counterbalancing it, especially when boring the end cylinders. The adjustment of the cylinder casting for obtaining the correct center-to-center distance between the bores was another point to be considered. The planetary or eccentric-head type of grinder, which is now in common use, is so arranged that the cylinder casting remains stationary while being ground, and it can be adjusted accurately for finishing the different bores in accordance with whatever center-to-center distance is prescribed. The principle of this machine is very simple. The grinding wheel, as it revolves rapidly about its own axis, is given a relatively slow circular or planetary motion, so that it is carried around the wall of the cylinder. At the same time, the cylinder, which is mounted on a carriage or slide of the machine, is given a lengthwise feeding movement which, for each complete circular movement of the wheel around the cylinder wall, is somewhat less than the width of the grinding wheel. The spindle-head of the grinding machine is so arranged that the eccentricity of the wheel-spindle or the diameter of the circular path it follows can be varied for grinding to whatever diameter may be required.

A cylinder grinding machine made by the Heald Machine Co., Worcester, Mass., is shown in Fig. 1, with a two-en-bloc cylinder mounted on the work-holding fixture. Independent drives are provided for the wheel-spindle and for the wheel-head, or the outer eccentric sleeve which contains the wheel-spindle and gives the latter its planetary motion. The arrangement of the driving belts is illustrated more clearly in Fig. 2, which shows a battery of these machines at the factory of the Packard Motor Car Co. One belt from the overhead countershaft drives the wheel-spindle through an intermediate connecting belt. A second belt from the overhead countershaft connects with a pulley near the base of the machine, which, through intermediate belts and gearing, drives the grinding-head or wheel-head and transmits a feeding movement to the work-table. A gear-box at the end of the machine provides four different speeds of rotation for the wheel-head, so that the planetary motion of the wheel can be varied for taking roughing and finishing cuts. A second gear-box, at the front of the machine column, gives three rates of feed for the work-table for each speed of the wheel-head. The feeding movements are independent of the rotary speeds of the wheel-head. The traversing movement, or stroke of the work-table, is adjusted by dogs at *A* and *B*, Fig. 1, which control the point of reversal. The work-table is arranged for a continuous reciprocating motion, but a stop is provided for disengaging the table feed at the point of reversal. On the main work-table there is a cross-slide which carries the work-holding fixture. This cross-slide has adjustable stops to locate the cylinder approximately for grinding the different bores. The exact center distance is indicated by a micrometer dial on the cross-feed screw.

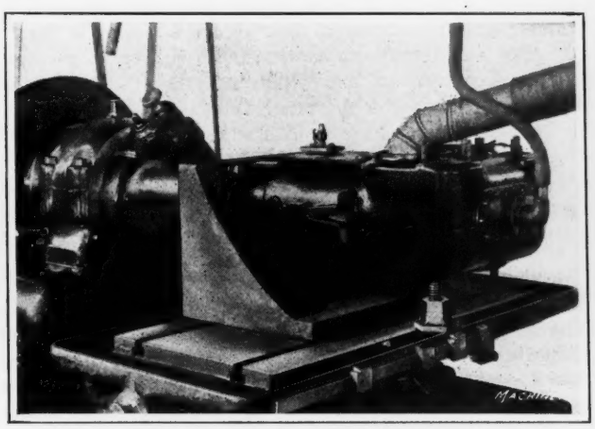


Fig. 5. Cylinder connected with Steam Pipe for circulating Steam through Jacket while grinding Bore

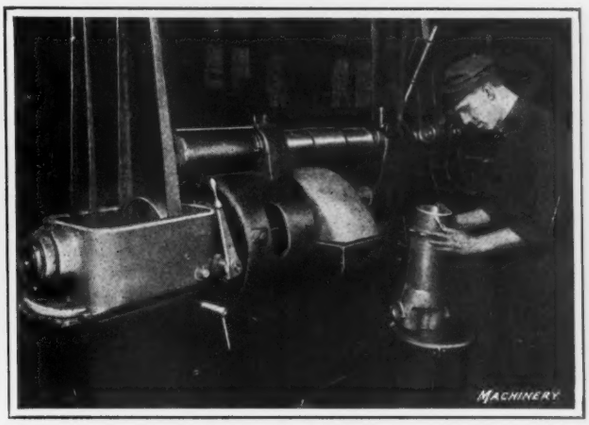


Fig. 6. Bryant Grinder operating on Airplane Motor Cylinder of the Type being inspected by the Operator

The depth of cut or diameter of cylinder bore can be regulated by the mechanism which varies the eccentricity of the wheel-spindle. If a rather large adjustment is necessary, a crank is applied to worm-shaft *F*, whereas for small adjustments, knob *C* is used. If the wheel-head is revolving slowly, this knob would ordinarily be employed for varying the depth of the cut, but if the wheel-head is rotating at the higher speeds, as for finishing, lever *D* is shifted, thus causing a star-wheel to turn one notch for each rotation of the wheel-head, which adjusts the wheel to an amount equal to about 0.00025 inch in radius. After one cylinder has been ground to the right diameter, dial *E* is set to the zero position and worm-shaft *F* is turned backward about one revolution, or far enough so that the wheel will clear the next hole to be ground. When grinding the next hole, the wheel may be fed in until dial *E* is again returned to the zero position. In this way unnecessary gaging or calipering is eliminated, and the graduations on the dial will greatly assist the operator in removing a given amount from the cylinder bore. As a true wheel is essential in cylinder grinding, diamond tools are used for truing, and these are generally attached to the face of the jig, as indicated at *G* in the illustration.

Another cylinder grinding machine of the eccentric head or planetary type is illustrated in Fig. 3. One belt from the overhead countershaft drives the wheel-spindle through an intermediate connecting belt, and a second belt rotates the wheel-head. The pulley for driving the wheel-head has two steps or diameters which provide two speed changes. Motion is transmitted to the outer eccentric sleeve through gears. The fixture on which the cylinder is supported is dovetailed to the carriage of the machine and can be adjusted laterally by the handle shown. The faceplate, to which the cylinder casting is clamped, is provided with vertical adjustment. The eccentricity of the wheel-spindle is varied by a small knurled handle, which is graduated to represent thousandths of an inch. This machine is manufactured by B. L. Schmidt Co., Davenport, Iowa.

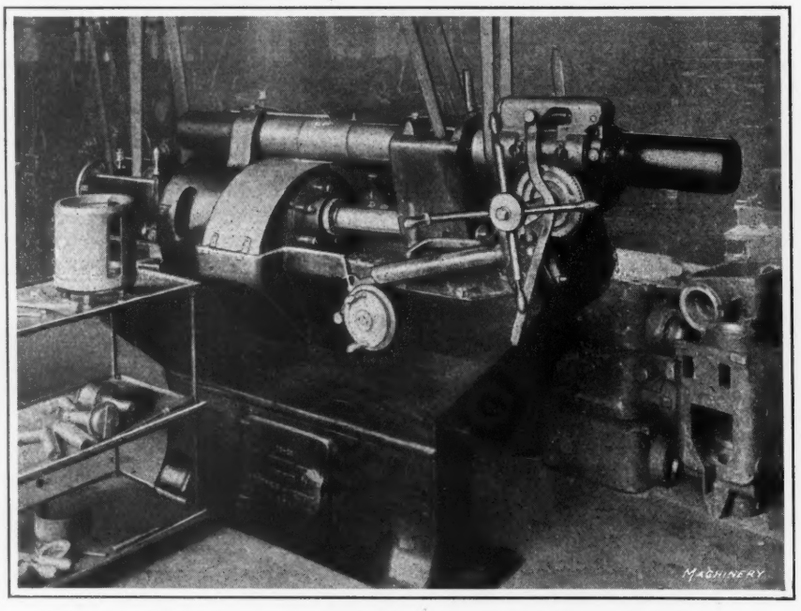


Fig. 7. Another View of the Bryant Grinder arranged for Airplane Cylinder Work

Cylinder Grinder Having Cross Adjustment for Grinding Head

The cylinder grinding machine to be described is so designed that the work-holding table is traversed parallel to the axis of the grinding-wheel spindle, but the cross adjustment for locating the wheel in alignment with different cylinder bores is obtained by changing the position of the grinding head. This machine is illustrated in Fig. 4, and, as will be seen, the grinding head or wheel-head is mounted on ways extending across the machine. A uniform tension is maintained on the driving belt, regardless of the position of the wheel-head, by an automatic belt-tightening device. After the cylinder has been mounted on the work-table, it is simply traversed with the work-table to obtain the necessary feeding movement, but the wheel-head is shifted in order to locate successive holes in position for grinding. The traverse of the table is controlled automatically by adjustable dogs which regulate the points of reversal. The wheel-head is of the double eccentric construction, which provides the necessary adjustment, and a micrometer dial is furnished to facilitate grinding accurately to the required size. This machine is the product of the Madison Machine Tool Co., 609 E. Washington Ave., Madison, Wis.

Rotation of Wheel-head and Feeding Movement of Cylinder

When a cylinder is being ground, the distance that it is fed in a lengthwise direction for each complete traversing movement or revolution of the wheel-head may vary from a fine feed up to about three-quarters of the wheel width. This relation between the rotation of the wheel-head or the planetary motion of the wheel around the cylinder wall, and the feeding movement of the cylinder itself, depends upon the hardness of the casting, the kind of wheel used, and the amount of metal to be removed by grinding. Even if all castings were exactly alike as to hardness and all grinding wheels absolutely uniform, a standard could not readily be established because of variations in the machines themselves, either as to design or condition. A new machine, to obtain the best results, might require a different method of operation than a much older machine of the same make, particularly if the latter were not in a good state of repair.

When taking roughing cuts, it is common practice to revolve the wheel-head at a slower rate than for finishing cuts (although the speed is sometimes reduced for finishing), and the feeding movement of the cylinder is equal to about one-half or three-quarters of the wheel width. A feed of three-quarters of the wheel width and light cuts are considered advisable if there is little stock to remove. If the grinding allowance is quite large, or the metal is rather hard to grind, deeper cuts and a finer feed are usually preferable. The leading corner of the wheel then does much of the work, and it is good practice to reverse the wheel on the spindle occasionally to distribute the wear on both sides.

Both coarse and fine feeds are used for finishing, the practice varying. The coarse feed, combined with light cuts, increases production and leaves a good surface if a true wheel is used, but many prefer finer feeds in order to eliminate slight feed marks and secure a smoother finish. Soon after an engine is in service, there will be no perceptible difference between the cylinders finished with the fine and with the coarse feeds, other things being equal. The wheels commonly used are ¾ inch wide. This width permits using a little softer grade than the ½-inch wheel, which formerly was quite generally used, and the wider wheel tends to decrease the time for grinding. The wheel should be trued before taking the light finishing cuts.

Circulating Water through Cylinder Jacket while Grinding

Water is often circulated through the jackets of cylinders while grinding the bore, in order to maintain a uniform temperature in the cylinder casting and prevent distortion. When a cylinder is ground without circulating water through the jacket, the heat generated by the grinding wheel causes the cylinder to expand. If the finishing cut is taken before the cylinder cools, the size of the bore will be reduced some-

what when the cylinder is cold and it may contract unevenly, owing to unequal distribution of metal in the casting; consequently it is difficult for the grinding machine operator to determine the allowance for this expansion, and as the cylinder is finished while heated, it may not be truly cylindrical when cold. To overcome these difficulties and maintain a uniform temperature in the casting, it is generally considered preferable to circulate water through the jacket and over the outside of the cylinder near the crank end or below that part of the cylinder which is not surrounded by the water jacket.

The most common practice is to use cold water, but some manufacturers prefer hot water. The object of circulating hot water through the jacket instead of cold is to grind the cylinder under conditions similar to those existing when the engine of which the cylinder forms a part is in actual use. The contention is that if the cylinder is ground true while heated by hot circulating water, it will assume this form, approximately at least, when heated while in service. The advantage of using hot water to obtain a true bore under operating conditions may depend considerably upon the design of the cylinder to be ground. Some cylinder castings expand and contract more uniformly than others. If the distribution of metal is such that the expansion causes considerable change in the shape of the bore, the greater degree of accuracy obtained by the hot water method may more than offset its disadvantages. As a general rule, it is much more convenient to obtain a supply of cold water than hot water. Another point to consider is the matter of inspection, as it is more difficult to finish cylinders within the prescribed limits of accuracy when the work is ground while hot and inspected while cold than when both the grinding machine operator and inspector measure a cold cylinder.

Circulating Steam through Jacket while Grinding Cylinder

Steam has been used by a few engine manufacturers for heating cylinders while grinding the bore, in order to grind them under temperature conditions at least somewhat similar to the actual working conditions. Fig. 5 illustrates the grinding of a two-en-bloc cylinder casting while heated to about 212 degrees F. The pipe supplying the steam is attached to the head end and connects with the steam heating system. The steam was allowed to pass through the water jacket and out of the small cock seen at the top of the casting near the crankcase end. A flexible hose connection is provided for the steam pipe to permit moving the cross-slide of the machine far enough to align the wheel with the two cylinder bores. The large pipe seen entering the cylinder is for exhausting the dust. When cylinders are ground while heated, they become distorted more or less when the casting is cool. In this particular case, the measurements made after the cylinder had cooled showed a distortion of about 0.003 inch, the cylinder tapering and being small at the explosion end.

Wet and Dry Methods of Grinding

The general practice is to grind cast-iron cylinders dry or without applying soda water or any other cooling medium to the wheel. The application of water should be confined to the water jacket and to the outside of the cylinder at the crank or unjacketed end. According to the experience of the Heald Machine Co. on tests made with wet grinding, this method reduces the efficiency of the grinding operation. The wheel cuts to better advantage when operating dry, and a better finish or surface is left in the cylinder bore. A wet wheel also tends to become loaded with dirt, which is not the case when grinding with a dry wheel of the right grade.

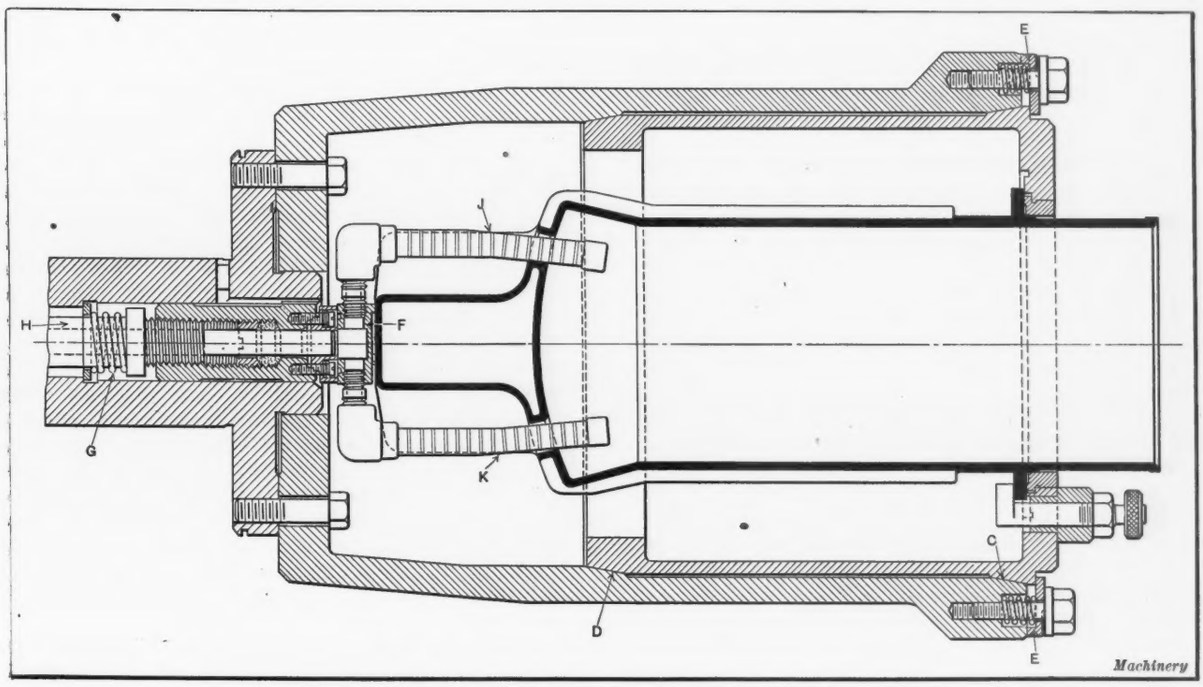


Fig. 8. Special Fixture for holding Airplane Cylinder while grinding Bore

Allowances for Cylinder Grinding

The allowance for cylinder grinding is about 0.008 or 0.010 inch under average conditions. The time required for finishing a cylinder bore by grinding may be affected considerably by the allowance. It is advisable to remove as much metal as practicable by the boring and reaming tool. The grinding allowance in some cases is as high as 0.040 or 0.050 inch, but it is not economical to remove so much metal by grinding. Excessive allowances are often due to neglect in maintaining the boring or reaming tools to the proper size. In some instances, cylinders are bored under size, so that they will be sure to "clean up" or be ground true. Under favorable conditions an allowance of 0.004 or 0.005 inch might reduce the grinding time, although as a rule this is working too close to the finished size and approximately 0.010 inch is preferable. Some manufacturers, however, have adopted these small allowances in order to reduce the grinding time, but they do the boring and reaming carefully. The cylinder bore prior to grinding need not have a smooth finish, but the bore should be true and square with the

finished face of the cylinder flange, because it is more economical to prevent excessive errors in machining than to correct them by grinding.

Grinding Airplane Engine Cylinders

The grinding of cylinders for airplane engines differs somewhat from ordinary cylinder grinding practice as applied to the cast-iron cylinders of engines for automobiles, trucks, motor boats, etc., partly because of the delicate construction of the cylinder. The machine illustrated in Figs. 6 and 7 is arranged for grinding the cylinders of Liberty motors. This is a deep-hole grinding machine made by the Bryant Chucking Grinder Co., Springfield, Vt. These airplane engine cylinders are steel forgings, and as the walls are very thin, it is of especial importance to equip the grinding machine with a fixture that will hold the cylinder for the grinding operation without any springing or distortion of the work.

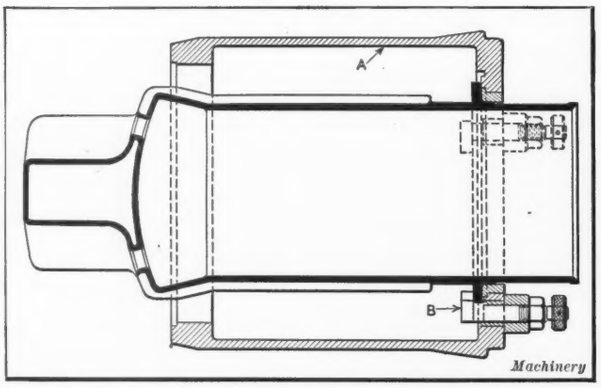


Fig. 9. Loading Sleeve in which Cylinder is placed before inserting into Main Fixture

The interesting design of the fixture developed for this class of work is shown by the sectional view, Fig. 8. The heavy black line in this illustration represents a section of the cylinder. This cylinder has a 5-inch bore and a grinding length of 11 inches. The fixture is in the form of a pot chuck, and almost entirely encloses the cylinder which is held in an auxiliary loading sleeve. The cylinder is first clamped in the loading sleeve, as shown by the detail view, Fig. 9. This sleeve *A* has five clamps of the type shown at *B* which hold the external flange of the cylinder firmly against a finished face of the loading sleeve. The sleeve and the cylinder as a unit are then placed in the main chuck, as shown in Fig. 8. The loading sleeve has conical surfaces at *C* and *D*, which engage corresponding surfaces in the chuck, thus accurately centering it. The sleeve is held in position by two clamps *E*. In order to steady the cylinder further without subjecting it to a clamping pressure that would cause a distortion of the thin wall, a spring plunger is located at *F*, which has a three-point contact and is held against the end of the cylinder by spring *G*.

Two loading sleeves are used with this method of chucking, which permits the operator to insert a cylinder in one sleeve while the machine is grinding a cylinder held in the other sleeve. These loading sleeves are also interchangeable with chucks on different machines, so that, if necessary, a sleeve and a cylinder can be kept together as a unit, and passed from one machine to another as might be required for roughing and finishing operations. The machine used for this work has an unusually long work-holding spindle to compensate for the long overhanging work chucks used for deep-hole grinding. Notwithstanding the unusual length between the work-spindle bearings, it is sometimes desirable, in the case of unusually long work, to use a steadyrest or outboard bearing for supporting the outer end of the work-holding chuck.

When the machine is in operation, the cylinder, of course, revolves while the wheel is traversed through it. The grinding is done wet, water or a suitable cooling compound flowing directly into the cylinder bore. The water passes through part *H* extending through the machine spindle, and then through the flexible tubes *J* and *K*, which pass through holes in the head end of the cylinder. The object of applying water directly to the bore when grinding these steel cylinders is to obtain as smooth a finish as possible and cool the cylinder wall uniformly so as to permit grinding faster without danger of distorting the wall by generating excessive heat.

After the boring operation, the cylinders have about 0.038 inch stock to be removed by grinding. About 0.030 inch is removed by a rough-grinding operation and the remainder by finish-grinding. Under average conditions, five cylinders are rough-ground per hour, and forty-seven cylinders have been rough-ground in nine hours on one machine. A 38-36 grade J alundum wheel was used, having a ¾-inch face and a diameter of 4½ inches. Experience has demonstrated that for the roughing operation, the machine will remove, on an

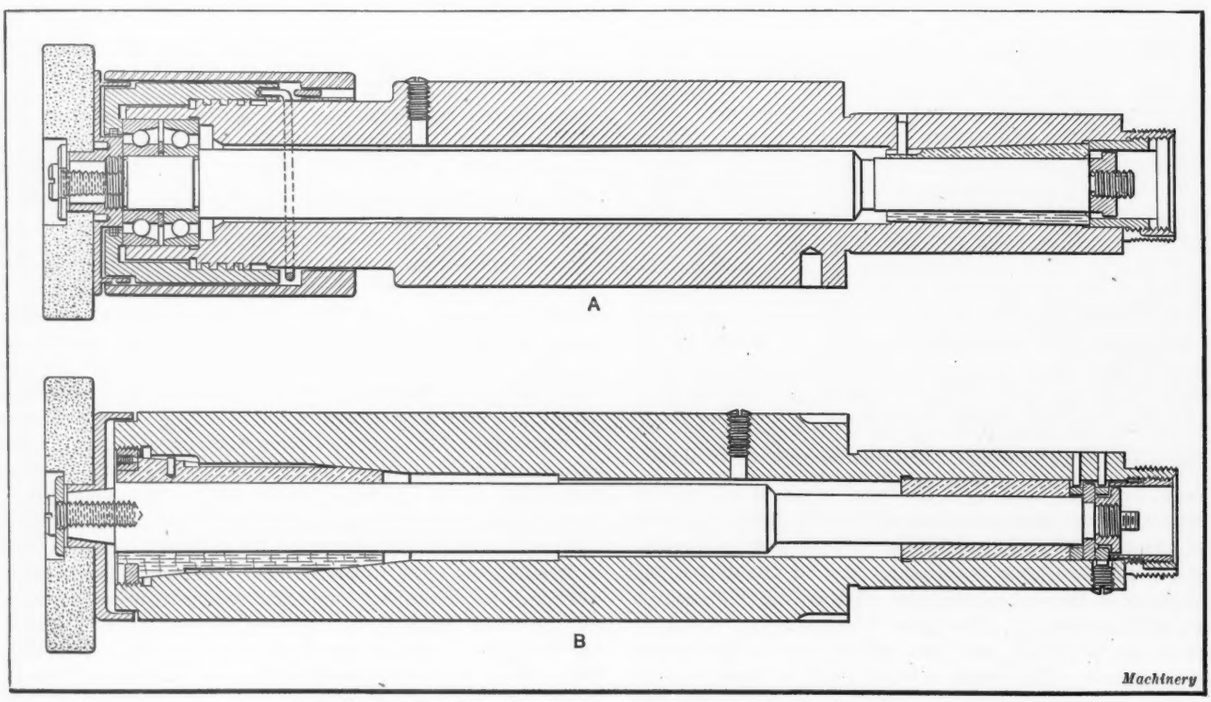


Fig. 10. Grinding Wheel-heads used for Roughing and Finishing Operations

average, 0.002 inch stock per minute (this time includes chucking the work), assuming that the cylinders have over 0.025 inch stock to remove. For operations of this kind, the ball bearing wheel-head shown at *A*, Fig. 10, is used. While this wheel-head is considered preferable for the roughing operation, it will not produce the fine surface required for the finished cylinder, and the bronze bearing wheel-head shown at *B* is used instead.

The average time for the finishing operation is approximately fifteen minutes per cylinder, and the average time for both the roughing and finishing operations is about thirty minutes per cylinder. At the Ford Motor Co. thirty airplane engine cylinders have been finish-ground in eight hours on one machine, and all of them passed the government inspection. The wheel used for the finishing operation was a 38-46 grade H or I alundum wheel, having a 1-inch face and a diameter of 4½ inches.

The table traverse for the roughing operation is about 3/16 inch per revolution of the work. The same rate of traverse is employed for finish-grinding until the cylinder is within about 0.003 inch of the finished size; then the slower traverse of about 1/16 inch per revolution of the work is used to obtain a finer finish.

Another example of airplane engine cylinder grinding is illustrated in Fig. 11. This view shows a Heald machine grinding a cylinder at the plant of the Hall-Scott Motor Car Co., Berkeley, Cal. In this case the cylinder is cooled by circulating water through the jacket. There are two water pipes, one connecting with the head end and the other with the lower end, thus providing a continuous circulation. The large pipe having a nozzle which extends to an opening on the lower side of the cylinder head, is for exhausting the dust and cooling the cylinder.

Fig. 12 illustrates how airplane cylinders are tested after grinding at the shop of Lewis & White, Syracuse, N. Y. An Ames dial gage is mounted on a base which is in contact with the cylinder bore along each side. As this base is pushed through the cylinder, with the indicating point of the gage bearing against the side of the cylinder, any diameter variations are readily detected. This simple form of gage not only shows any taper in the bore, but also indicates lack of roundness, the cylinder being turned so that the diameter can be tested across different parts of the bore. This general type of gage has also been used extensively for testing cylinders of automobile and airplane motors.

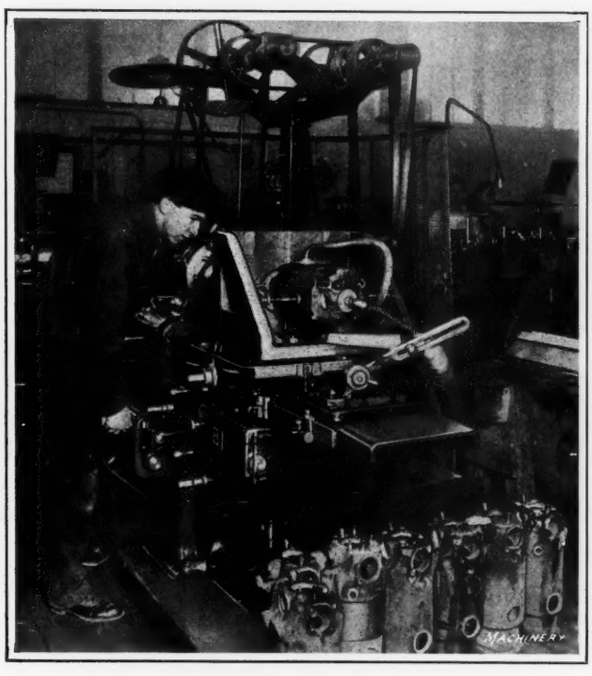


Fig. 11. Another Example of Airplane Cylinder Grinding

Fig. 12. Testing Accuracy of Ground Airplane Cylinders

The next and concluding article will describe cylinder grinding in automobile plants; grinding cylinders of stationary gas engines and fire-engine motors; fixtures for holding cylinders while grinding; and cylinder grinding attachment. Information will also be given on selecting wheels for cylinder grinding.

* * *

THE FIFTH LIBERTY LOAN—THE VICTORY LOAN

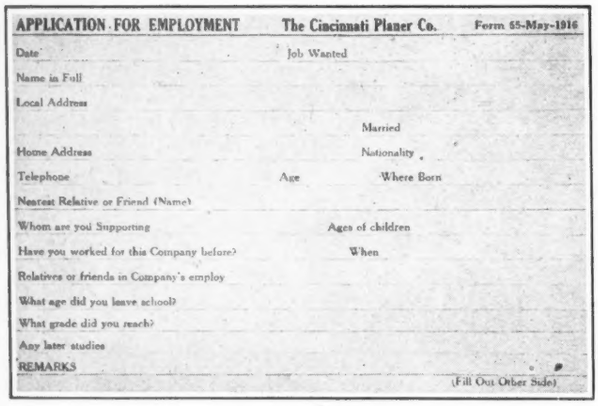
America always finishes what she starts. This dictum has been the guiding rule to success in the United States as a whole and as individuals. We started in the world war with a firm determination to go through with it to the end, and we had no doubt as to our ability to finish it successfully. The peace gathering in Paris is evidence of our success in arms. That success is the result of a bravery and devotion to a cause which, on the part of many Americans, meant death long before the armistice was signed. We are now getting ready to finish, absolutely and for all time, the task of insuring the safety of democratic ideals. This finishing touch is the successful flotation of the new Victory Loan.

At the time of the signing of the armistice, as Secretary of the Treasury Carter Glass has pointed out, the manufacture of munitions and supplies for our Army in France, and for our men in the training camps at home, had about reached the peak of production. December's bill for war costs was running into billions. The Victory Loan, the fifth of the war bond issues of the Government, will be for an amount estimated by the Secretary of the Treasury at $5,000,000,000, and this will enable the Government to finish payment of its war costs. Every American should feel it a privilege to assist in raising this amount.

Finish the job! That is still the actuating impulse of American business. It applies fitly to what is now our biggest business in hand—putting over the Victory Loan. We cannot honestly say that we have achieved the satisfaction of a job well done until we have paid the bills for munitions, paid every soldier and transported him home, provided for the after-care of the wounded, and poured into the national coffers enough money to place the United States on the way to permanent prosperity. Our prime agency for doing all this is the Victory Loan.

* * *

The Bureau of Navigation of the Department of Commerce reports that during the calendar year 1918, private American shipyards built 1834 merchant vessels, representing a total of 2,622,588 gross tons for American ship owners. American ship builders also built 48 vessels of 98,693 gross tons for foreign owners, making a total output of 1882 vessels of 2,721,281 gross tons for the twelve months.


APPLICATION FOR EMPLOYMENT The Cincinnati Planer Co. Form 55-May-1916

Date Job Wanted

Name in Full

Local Address

Married

Home Address Nationality

Telephone Age Where Born

Nearest Relative or Friend (Name)

Whom are you Supporting Ages of children

Have you worked for this Company before? When

Relatives or friends in Company's employ

What age did you leave school?

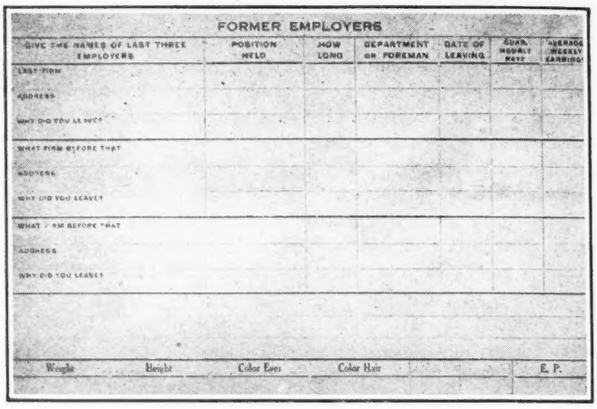
What grade did you reach?

Any later studies

REMARKS

(Fill Out Other Side)

Fig. 1. Front of Application Card


FORMER EMPLOYERS

GIVE THE NAMES OF LAST THREE EMPLOYERS	POSITION HELD	HOW LONG	DEPARTMENT OR FOREMAN	DATE OF LEAVING	QUAR. HOURLY RATE	AVERAGE WEEKLY EARNINGS
LAST FIRM						
ADDRESS						
WHY DID YOU LEAVE?						
WHAT FIRM BEFORE THAT						
ADDRESS						
WHY DID YOU LEAVE?						
WHAT FIRM BEFORE THAT						
ADDRESS						
WHY DID YOU LEAVE?						

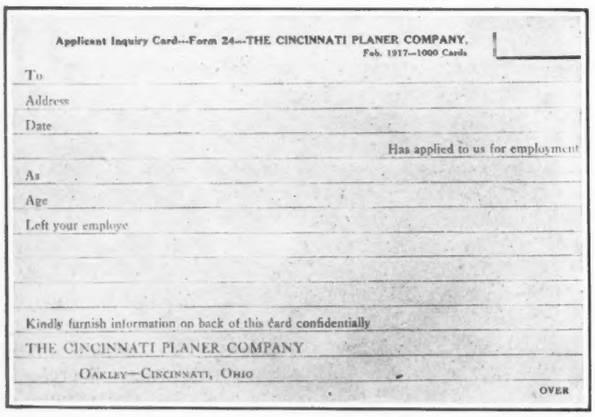
Weight Height Color Eyes Color Hair E. P.

Fig. 2. Back of Application Card

EMPLOYMENT SYSTEM OF CINCINNATI PLANER CO.

By A. J. SCHNEIDER, Employment Manager, Cincinnati Planer Co., Cincinnati, Ohio

THE employment system in use at the Cincinnati Planer Co.'s shops has been worked out in such a way as to give the employment manager entire charge of this department, the foremen being relieved of all responsibility connected with the employment problem. Contrary to some employment systems, the responsibility and work of the employment department is not confined to the actual hiring of help, but includes also what may be termed the information bureau and the employes' service department. The welfare of the men and all records showing their characteristics and ability are also handled in the employment department.


Applicant Inquiry Card---Form 24---THE CINCINNATI PLANER COMPANY. Feb. 1917---1000 Cards

To

Address

Date

Has applied to us for employment

As

Age

Left your employe

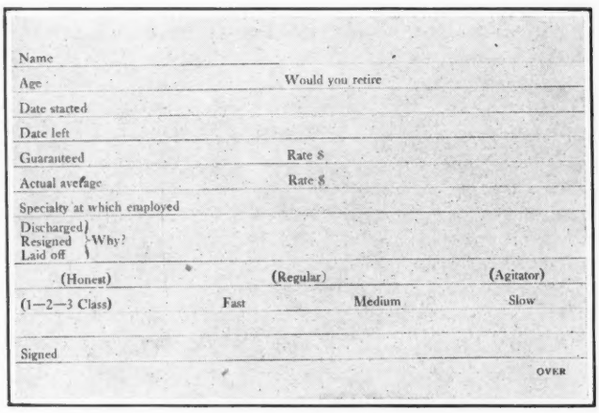
Kindly furnish information on back of this card confidentially

THE CINCINNATI PLANER COMPANY

OAKLEY—CINCINNATI, OHIO

OVER

Fig. 3. Front of Inquiry Card


Name

Age Would you retire

Date started

Date left

Guaranteed Rate $

Actual average Rate $

Specialty at which employed

Discharged / Resigned / Laid off } Why?

(Honest) (Regular) (Agitator)

(1—2—3 Class) Fast Medium Slow

Signed

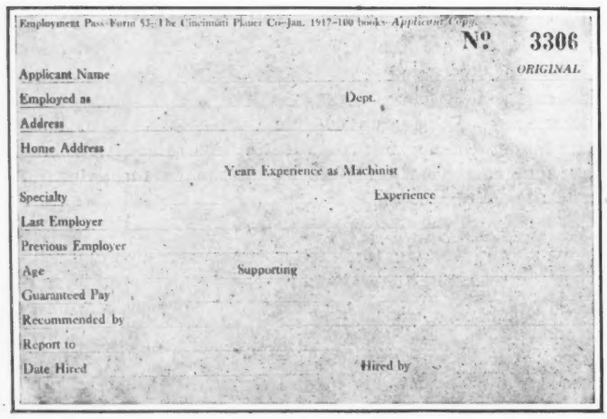
OVER

Fig. 4. Back of Inquiry Card

Employe Record Cards

The system involves the maintenance of five sets of records, the forms for which are shown in the accompanying illustrations. There are four forms, each of which is 4 by 6 inches in size, and a daily report sheet. The application or employment card, shown in Figs. 1 and 2, is filled out by the applicant if his education will permit, or if not, he writes his name and the employment department fills in the other information. If the applicant is employed, he is given an employment pass such as shown in Fig. 5. This form is made out in triplicate, the original being retained by the employe as an identification slip, and as an introduction to his immediate superior, who is usually the foreman of the department. The duplicate form goes to the foreman, and the third or triplicate form is filed in the employment department.

Figs. 3 and 4 show both sides of the applicant inquiry card, which calls for the previous record of the applicant ob-


Employment Pass-Form 53--The Cincinnati Planer Co--Jan. 1917--100 books--*Applicant's Copy*

No. 3306

ORIGINAL

Applicant Name

Employed as Dept.

Address

Home Address

Years Experience as Machinist

Specialty Experience

Last Employer

Previous Employer

Age Supporting

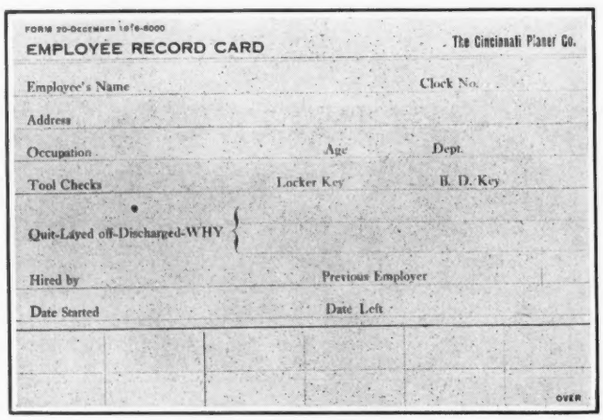
Guaranteed Pay

Recommended by

Report to

Date Hired Hired by

Fig. 5. The Employment Pass Form


FORM 70-DECEMBER 1916-5000

EMPLOYEE RECORD CARD The Cincinnati Planer Co.

Employee's Name Clock No.

Address

Occupation Age Dept.

Tool Checks Locker Key B. D. Key

Quit-Layed off-Discharged-WHY

Hired by Previous Employer

Date Started Date Left

OVER

Fig. 6. Front of Employe Record Card

tained from his former employer. This record is not ordinarily made use of by the Cincinnati Planer Co., except for obtaining such information as length of service, specialty of occupation, and a few minor details which may be of use in keeping records. It is not used as a check method or means of probe. The report of former employers does not regularly govern the course of action of the employment department, because it has been learned that such reports are frequently erroneous, and also that many employers do not keep such information on file as is recorded on the inquiry cards. It also often happens that, although an employe may have had a questionable record in the past, in a new environment he frequently proves to be a valuable man. The employment record card, Fig. 6, is used to keep a complete record of the data pertaining to the worker. The back of this card contains a list of characteristics, as shown in Fig. 7. The cards are filed according to the clock number and also according to the department name, both in an open file. These cards, arranged according to the date when the worker leaves the employ of the company, are kept in a closed file.

YES	CHECK WHICH	NO
	1-2-3 Class Employee	
	Obedient	
	Energetic	
	Regular	
	Loyal	
	Truthful—Honest	
	Temperate	
	Union	
	Agitator	
	Desirable	
	Talks too much	

Fig. 7. Back of Employe Record Card

Employe Report Sheets

In addition to these forms, the department prepares daily, weekly, monthly, and yearly report sheets pertaining to labor turnover, absenteeism, tardiness, group insurance, etc. The daily reports are made out on a blank, such as shown in Fig. 8. They are filled in every morning in triplicate by the timekeeper, and are distributed to the employment department, the superintendent, and the works manager. These sheets are looked over each morning by the superintendent, special notice being taken of absent and late employes, and the proper action is taken when necessary. The daily sheets, of course, are used in preparing the weekly, monthly, and yearly reports. Employes are not permitted to be late more than once a week without furnishing some good reason.

As a reward for faithful attendance, all employes who have not been absent from work or who have not been late during the month, except for causes approved by the management will be credited in the Christmas savings fund record with an amount equal to 5 per cent of their total monthly earnings. This fund draws interest, and the total amount accrued monthly is payable on December 24 to every employe who has complied with the conditions and who is still in the company's employ. A slip showing the amount held in reserve for each worker is placed in the pay envelope each month. Any employe having a perfect record for the year, that is, who has never been late or absent, will receive an extra 5 per cent of his earnings, and all those who have been late or absent but once will receive an additional 2 per cent.

Conditions Governing Entering and Leaving the Employ of the Company

When, after being duly hired and a guaranteed rating having been fixed, the employe reports for work, he must enter by a special door, where he is identified and given a time-clock number, ten tool checks, and a locker key. Thereafter, however, the new employe will use the regular entrance, change his street clothes and hang them in his locker, and after ringing his number on the time-clock, should be in his place and in readiness to start work promptly at the sound of the bell.

On leaving the employ of the company, three days' notice is required in order that payment of wages in full may be made when leaving. During these three days, the employe must be at his work. All tools must be returned to the store-room and the checks obtained, in order that the full number of checks charged to the employe may be returned, together with the locker key. When these requirements have been met, a release card is issued which must be signed by the foreman, toolkeeper, timekeeper, superintendent, and employment manager before the full settlement pay is received.

* * *

A recent article in the *Journal* of the A. S. M. E. gives some interesting information in regard to the development of radio telephony for use on aircraft. It is said that it is now possible to communicate by this means from aircraft in flight to stations on land at a maximum distance of sixty miles. Telephone communication from land stations to flying craft is practicable at a distance of fifteen miles.

DAILY REPORT OF EMPLOYEES, MARCH, 1917-FORM 6. THE CINCINNATI PLANER COMPANY.

Clock No.	ABSENT (Name)	Note	Dept.	Clock No.	LATE (Name)	Time	Note	Dept.

Clock No.	INCOMING (Name)	Address	Specialty	T Cks	L Key	E Key	Date Started	Dept.

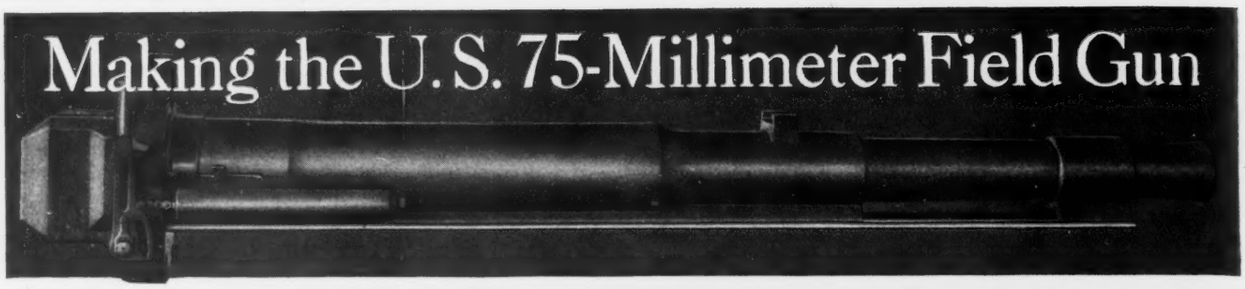
Clock No.	OUTGOING (Name)	Dis. Quit L.D. Trans.	Reason	Specialty	T Cks	L Key	D Key	Date Left	Dept.

How Many?	HELP WANTED	Note	Dept.

Day Date (Over) Mach'y

Fig. 8. Daily Employe Report Sheet, which forms the Basis for the Weekly, Monthly, and Yearly Reports

Making the U. S. 75-Millimeter Field Gun



First of Two Articles Describing the Methods Developed by the Wisconsin Gun Co., Milwaukee, Wisconsin in Producing Light Field Artillery

BY ERIK OBERG

The manufacture of guns, both of small and large caliber, involves a great many interesting machining operations, and the methods employed are of value not only in the making of ordnance material, but also in the manufacture of machinery used for peaceful industrial purposes. The boring and reaming of long accurate holes, for example, is an operation by no means confined to guns, although it reaches its highest development in gun making. Hence, although the war is over, these articles should be of both interest and value to men engaged in mechanical work.

LATE in the summer of 1917, five concerns in Milwaukee, Wis., began to investigate, at the request of the Ordnance Department, methods for the manufacture of 75-millimeter field guns, and prepared plans which were submitted to the Ordnance Department for the erection of a plant to manufacture three guns of this size in ten hours. These plans having been approved, the five companies cooperated in the building and equipping of a new plant located in Milwaukee, forming a company to operate the plant known as the Wisconsin Gun Co. The five companies that were requested to undertake this work were the Bucyrus Co., the Cutler-Hammer Mfg. Co., the Kearney & Trecker Co., the Northwestern Malleable Iron Co., and the Power & Mining Machinery Co.

The building operations began in the early autumn, and in fifty-one days from the time the ground was broken, a plant 130 by 300 feet was built and equipped, cranes were installed and ready for service, and the tool-room was in operation, turning out the tools required for the making of the ordnance to be built in the plant. Since that time an addition has been built, doubling the capacity of the plant and making it possible to turn out six guns a day. The guns first built in the plant are known as the 75-millimeter U. S. Model 1916 field guns. The guns are completed, ready to mount upon their carriages, but the carriages themselves are not made in this factory. As shown in Fig. 1, the gun is 7½ feet long and weighs about 1000 pounds. Lately the firm has changed to the manufacture of a still more recent model—the French 75-millimeter gun. H. J. Wiegand, formerly superintendent of the Cutler-Hammer Mfg. Co., was made general manager of the plant.

The four principal parts of the gun are the tube, the jacket, the breech-ring, and the breech-block. The tube, jacket, and breech-ring are first machined and are then fitted together with shrink fits. The tube comes from the forging shop to the plant of the Wisconsin Gun Co. rough-turned, and with a hole rough-bored. This turning and boring, however, is all that the word "rough" implies, and further roughing cuts must be taken before the final finishing cuts can be attempted. A great many novel and interesting methods have been developed in handling the work of boring, reaming, and rifling the bores of the tubes, as well as for the finish-planing and milling of the outside, which, on account of numerous projections, cannot be turned.

Telltaling and Spotting

The first operation on the tube, after it has been received in the shop, is to "telltale" and spot the outside for the chucks or steadyrests in which it will be held during subsequent operations. The method used for telltaling is to place the end of the tube in a standard, independent, four-jaw chuck, held on the spindle of a heavy lathe, and support the other end in an adjustable steadyrest. In this way both ends of the tube may be adjusted in any direction to suit the hole or bore. The object of the operation is, of course, to get the bore of the tube adjusted until it is reasonably true, so that, after the spots have been turned on the outside of the tube for supporting it during subsequent operations, the bore will clean up properly, and there will be sufficient metal for finishing the gun as required, both in the bore and on the outside.

For the actual truing-up work, the well-known method of using a telltale bar is employed. Fig. 2 shows the machine in which this work is done without a tube in position. It shows the telltale bar, the steadyrest which supports the tube at the outer end, the chuck in which it is held at the head end, and also the cone-shaped cutter-head held in the spindle of the lathe, which is used for centering the tube at each end, so as to provide a center that will be true with

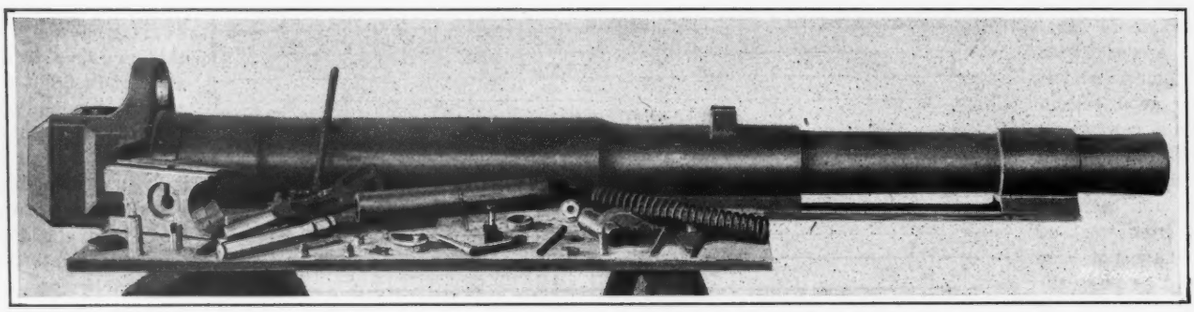


Fig. 1. The U. S. 75-millimeter Field Gun Ready to be assembled

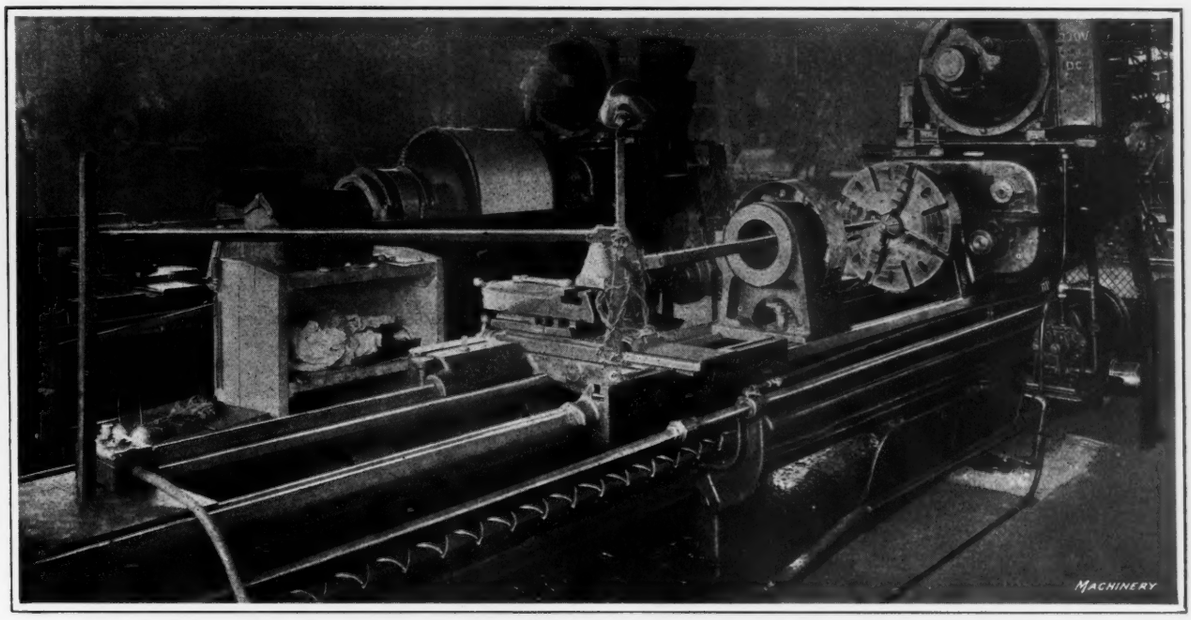


Fig. 2. Machine in which the Rough Tube is trued up

the spots being turned on the outside. This method is novel, as it provides at once for centers and spotted outsides true with each other. The cone-shaped cutter for centering the tube is fed through the spindle. The head end of the machine is shown in Fig. 3, the cutter being fed forward by the turning of the handwheel mounted on an elongation of the spindle. In Fig. 4 is shown the tube mounted in the lathe, and the telltale bar can be seen inserted in the tube. The tubes are now spotted, the spots being located as indicated in Fig. 5, which shows one spot at the end of the tube for holding it in a draw-in collet, while the other spot is near the other end for the jaws of a steadyrest.

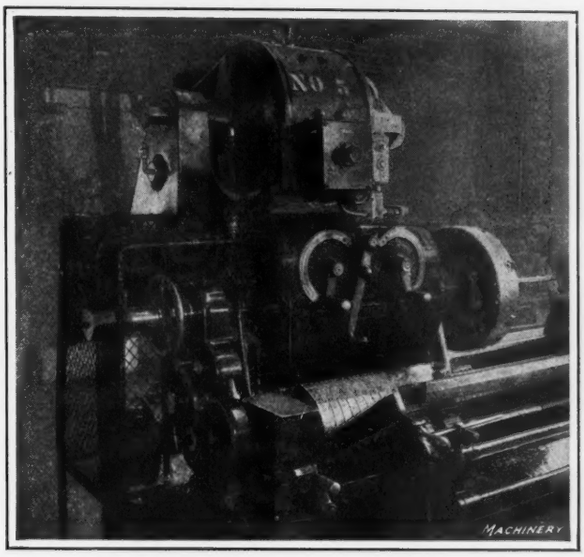


Fig. 3. Head End of Machine in which Tube is trued up, showing Handwheel for feeding the Cone-shaped Cutter

Boring the Tubes

An interesting feature in conjunction with the work done at the Wisconsin Gun Co. is that most of the machines are standard machine tools adapted to the particular work in hand. For boring, an American Tool Works Co.'s 24-inch standard engine lathe is used. Fig. 5 shows the tube pulled away from the collet in which it is held while boring, in order to show the collet clearly. A dog driver is used in addition to the clamping action of the collet, in order to prevent any possible slipping. This driver is shown in Fig. 6, where the tube may be seen mounted in the lathe ready for the rough-boring operation. Fig. 7 shows both the roughing and the finishing tools or pack-bits used. The roughing tools are shown to the right and the finishing tools to the left. In each case, one of the tools has the wood packing removed, as well as one of the cutters. These tools are made according to the usual method for gun-boring tools, having two cutters in each and the body packed with maplewood. Fig. 13 shows the details of the cutting tools, both for the roughing and for the finishing operations. The roughing tool cuts on the end and the roughing cutters are made from high-speed steel. The finishing cutter cuts on the side, and is made from high-grade tool steel. Figs. 12 and 14 show the boring tool for the tube and jacket, respectively.

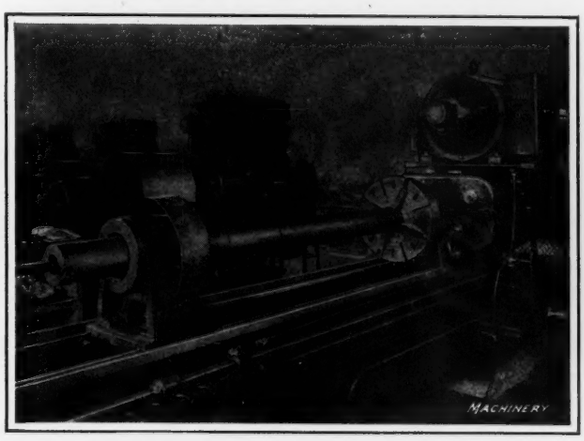


Fig. 4. Tube mounted in Lathe with Telltale Bar in Position

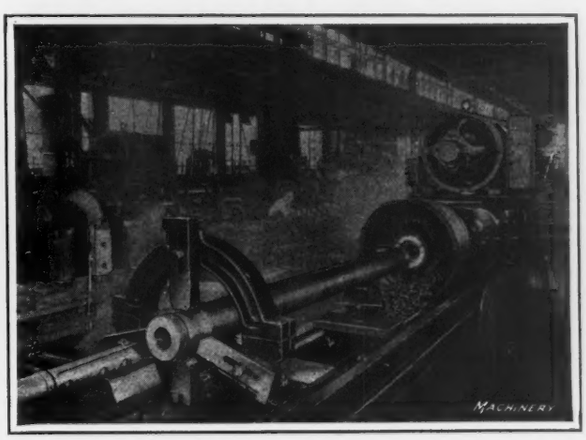


Fig. 5. Spotted Tube showing Trued Up Spot for Steadyrest

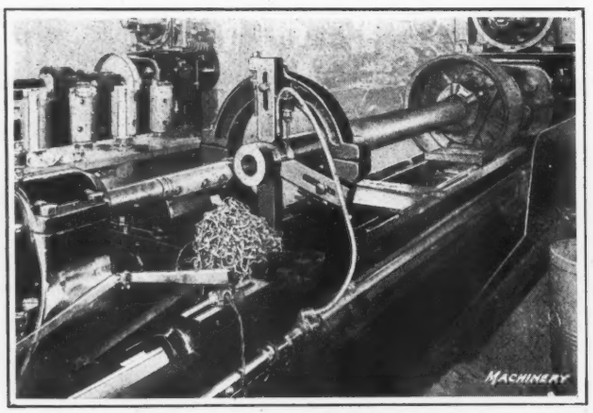


Fig. 6. Tube mounted in Lathe Ready for Rough-boring

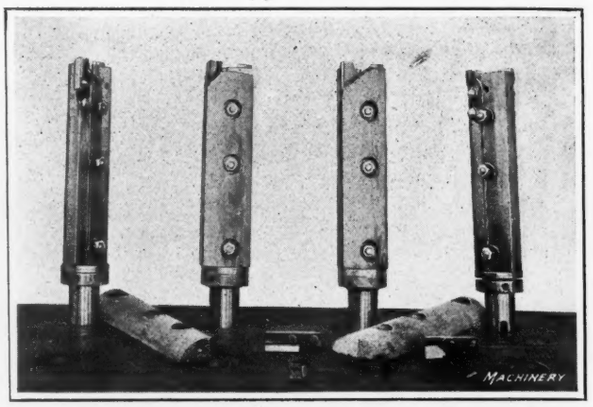


Fig. 7. Roughing and Finishing Tools for Gun-boring

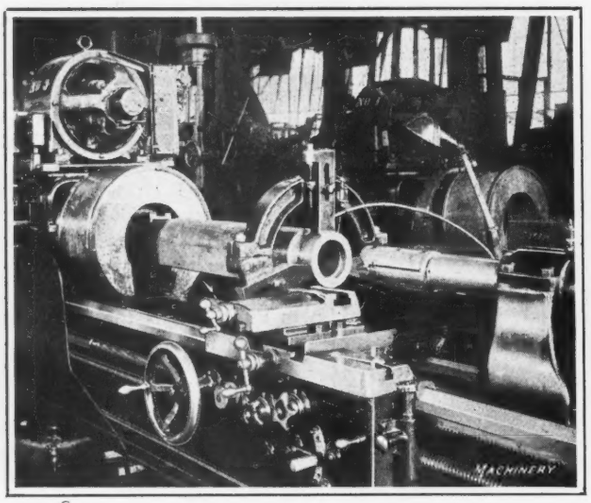


Fig. 8. Jacket in Position to be bored

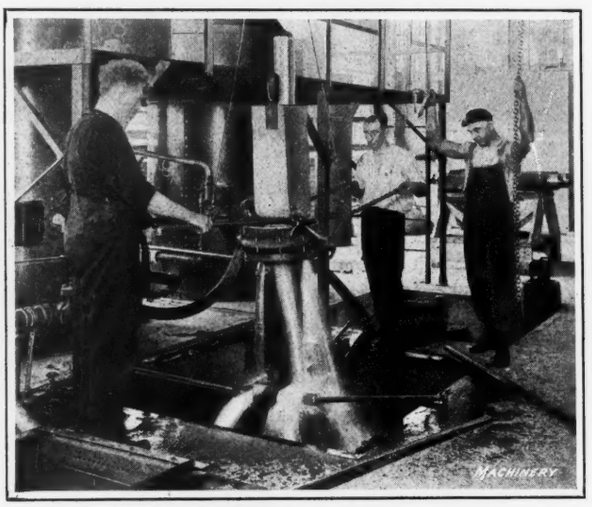


Fig. 9. Method of cooling Jacket

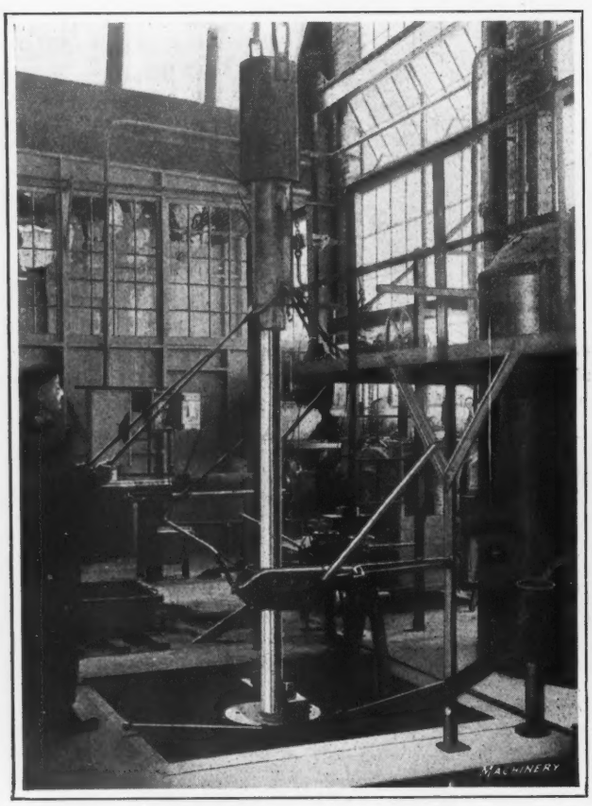


Fig. 10. Shrinking the Jacket onto the Tube

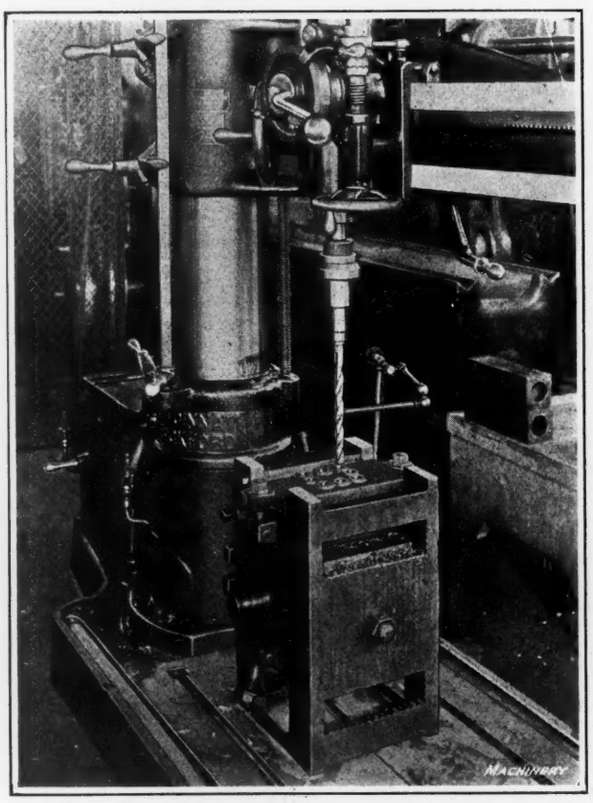


Fig. 11. Drilling Holes in Breech-ring

After the tube is placed in the lathe, a starting cut is made at the end of the bore by a single-point boring tool, to the size to be bored by the roughing cutter. After this starting cut has been made true, the roughing and finishing cutters will follow true, and this will insure that a straight hole will be bored. The roughing cutter leaves 0.015 inch on the diameter (0.0075 inch on a side) for the finishing cutter to remove. A coarse feed is used for the latter cutter, and as it cuts only on the side, an extremely true hole and a nicely finished surface is produced. In fact, the usual practice followed in many other gun plants, of lapping the gun bore after the finishing cutter or reamer has passed through, has been found unnecessary, and an almost unbelievable accuracy of truth in the bore, as regards the hole not being tapered or out of round, has been obtained. In fact, the accuracy is within 0.0002 inch in 100 inches.

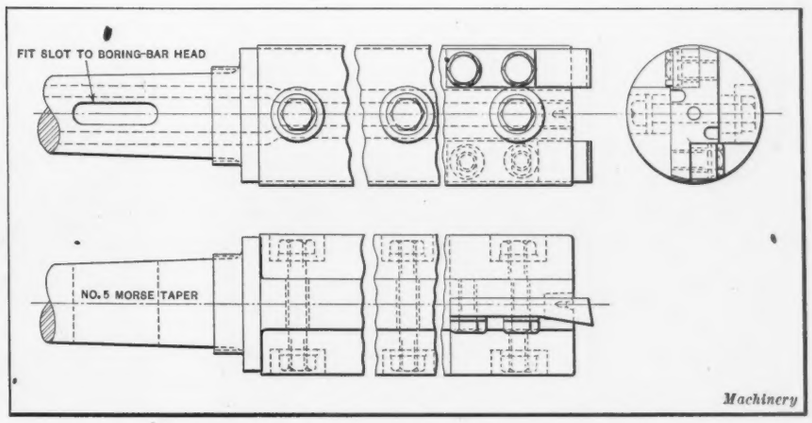


Fig. 12. Complete Boring Tool for Tube

Boring the Jacket

The jacket is bored in much the same manner as is the tube. As shown in Fig. 8, the jacket is supported at one end in an adjustable pot chuck, while it is held at the other end in a steadyrest. A wood-packed boring tool or reamer of the same type as those used for the tube is employed, and it is shown in the illustration ready to enter the bore for the finishing cut. As the jacket is shrunk onto the tube, the tube is turned and ground to the required dimension on the part onto which the jacket fits, and 0.006 inch is allowed in the bore for the shrink fit. By the method used for finishing the hole in the jacket, it has been found possible to bore the hole so accurately that it will properly fit the tube with a shrink fit for the full length of the bore in the jacket when the tube and the jacket are both made to the mean theoretical diameters. In many instances, gun manufacturers are not able to obtain a bore in the jacket that is true enough so that the tube can be finish-ground to a mean diameter. The maximum variation permissible in the jacket is 0.001 inch. Should the variation be greater, it would be necessary to turn minute humps or elevated spots on the tube to correspond to the inaccuracies in the jacket bore so that, when the two were shrunk together, there would be a uniform and close fit at all points. This method of adopting the outside of the tube to the bore in the jacket is, however, unnecessary when the bore is produced by the methods described, proper attention, of course, being paid to having the machines and tools in good condition and to performing the operations with the greatest care.

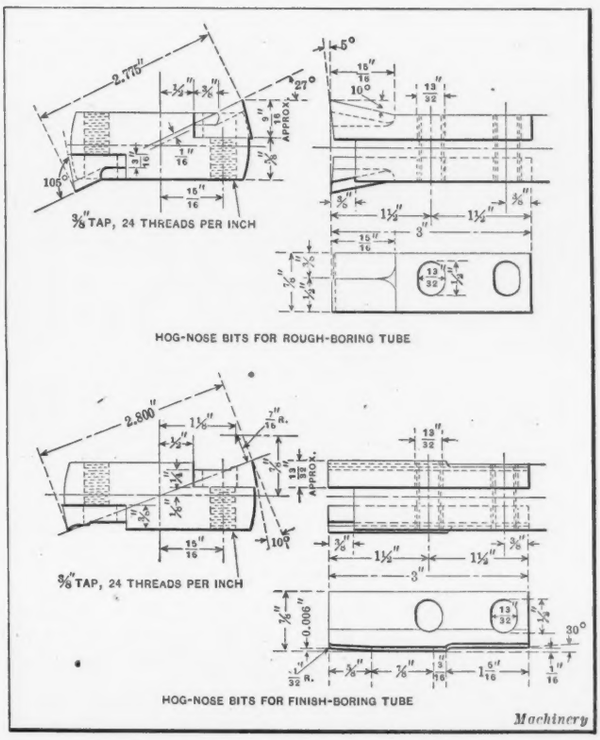


Fig. 13. Details of Boring Tools for roughing and finishing Gun Tube

Shrinking the Jacket onto the Tube

The next operation is to shrink the jacket onto the tube. The tube is held in a vertical fixture and the jacket is heated in a furnace and let down over the tube. The upper end of the jacket is covered with a boot during this operation, as shown in Fig. 10. This boot is clamped to the jacket, during the shrinking process, at its thinnest section; that is, at the place where it would contract first if exposed fully to the outside air. This covering or boot keeps the jacket expanded long enough—even at the thinnest section—so that it will drop down the full length to the shoulder on the tube, against which its end rests. The boot, in fact, is simply a heat insulator made from cast iron. Fig. 9 shows the method of cooling that is employed after the jacket has come in contact with the shoulder against which it rests. Cooling water is first forced through a stationary spray, which is so placed that water will first be applied at the extreme end of the tube at the shoulder. This forces the jacket at this point to grip the tube and prevents it from pulling away from the shoulder. Then, an adjustable spray, as shown in the illustration, is moved upward until the whole jacket is cooled off, after which the boot is removed and the jacket and

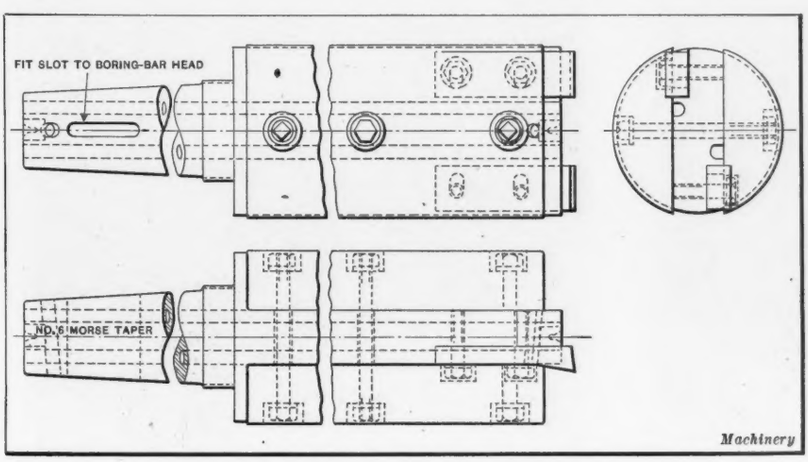


Fig. 14. Complete Boring Tool for Jacket

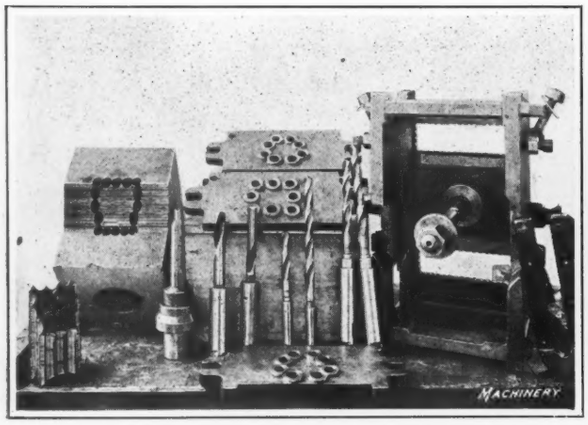


Fig. 15. Jig shown in Fig. 11 with Three Jig Plates and Work that has been drilled

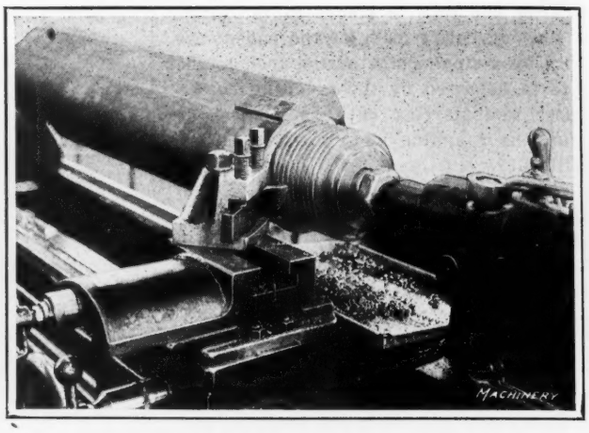


Fig. 16. Threading the End of the Jacket for a Shrink Fit in the Breech-ring

tube combination is put into a lathe, and the jacket end is threaded for a shrink fit in the breech-ring (see Fig. 16).

Operations on the Breech-ring

There are some interesting operations performed on the breech-ring to which attention may be called, although most of the work on this part is comparatively simple. In order to remove the material for the breech-block proper, a series of holes is drilled in the breech-ring, so that the part to be removed finally can be knocked out of place with a hammer blow. An interesting jig is used for this drilling operation, which is performed on a radial drilling machine as shown in Fig. 11; the drills, the jig and its parts, as well as the breech-ring with the part for the breech-block ready to be removed, are shown in Fig. 15. In the same illustration, the removed part is also shown in the lower left-hand corner. The noteworthy feature of the jig shown in Fig. 15 is that it is provided with three removable top plates, whereby it is possible to drill the holes close enough in the breech-ring so that the chunk of metal to be removed can be easily knocked out. The illustration also shows to the left the hog-nose type of drill that is used for starting those holes that have to be drilled at an angle, as indicated by the shape of the pieces to the left. Of the three jig plates shown, one is for the holes drilled at an angle. The one shown at the bottom is used first. The one at the top is the one next employed, and the one shown in the middle is used last. This jig plate is the one shown in position in the jig in Fig. 11.

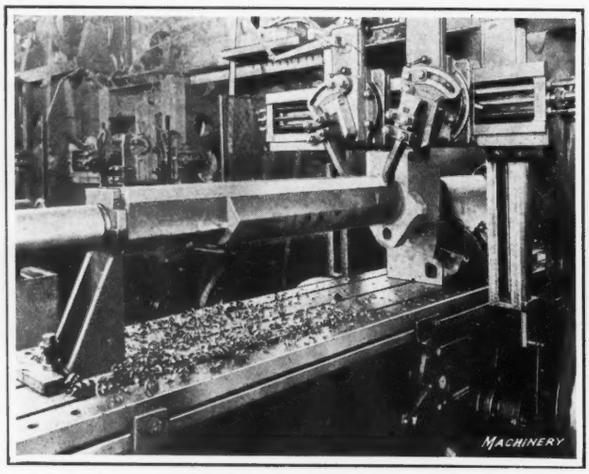


Fig. 17. Planing Bottom and Side of Recoil Slide

The breech-ring is bored and threaded on a Warner & Swasey turret lathe, as shown in Fig. 18, and after having been threaded, it is shrunk onto the jacket. A shrink fit is obtained on the threads, the ring being threaded onto the jacket after having been heated, so that the joint may be called a "threaded shrink fit." The thread on the end of the jacket is shown near the floor line in Fig. 19. The method of assembling the jacket and the breech-ring is as follows: The breech-ring, after having been heated to the proper temperature, is taken from the furnace and is held in a fixture, the top of which is flush with the floor level, as indicated in Fig. 19. The combination jacket-tube is then lowered from above by means

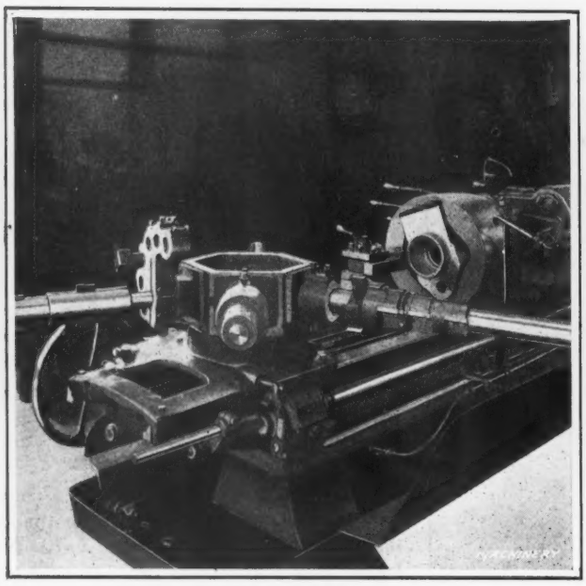


Fig. 18. Boring and threading the Breech-ring on a Turret Lathe

Fig. 19. Assembling the Jacket and Breech-ring by Shrink Fit

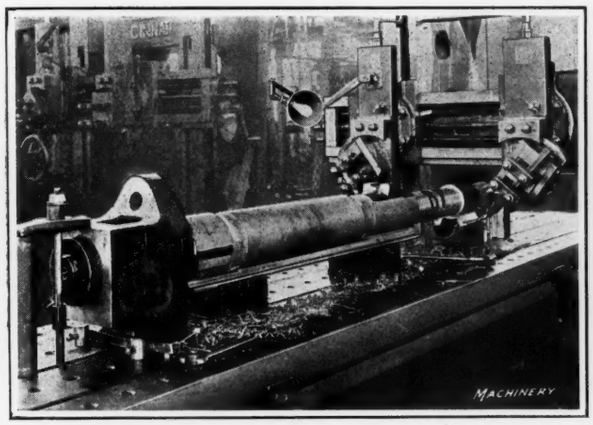


Fig. 20. Planing Circular Portion of Outside of Gun

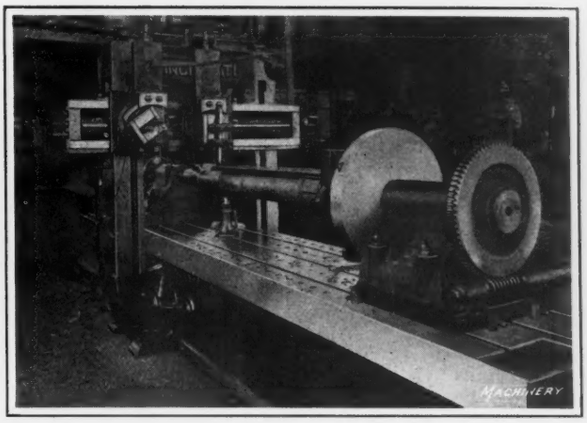


Fig. 21. Fixture for rotating the Gun Body while planing

of a crane, which is provided with a special spring hook, allowing the thread on the jacket to be started easily in the breech-ring. A split handwheel is placed around the jacket as indicated, the diameter of this handwheel being amply large enough so that the necessary leverage for screwing the jacket in place is obtained. The threads on the jacket and in the breech-ring are so located with reference to each other that, when screwed together, the jacket will line up properly with the base of the breech-ring.

When the jacket and the breech-ring are shrunk onto the tube, the combination of the three parts is called a "gun body." The gun body is now ready for finishing the outside, which consists mainly of planing operations, due to the peculiar shape of the outside of the gun, which is made integral with the recoil slide, and for this reason cannot be turned on the outside in a lathe. Before the operations on the outside are performed, however, the gun body is placed in the tube boring lathe and the bore is finished, an operation which is made necessary on account of the compression in the tube due to the shrinkage operation. The same finishing tool is used for the final boring or reaming as was employed for the finish-reaming before the jacket was assembled with the tube. This final boring or reaming leaves the hole as nearly true as it could be made by any ordinary machining operation. The gun is rifled after it has been finish-bored and the powder chamber reamed. The rifling is performed on a standard rifling machine.

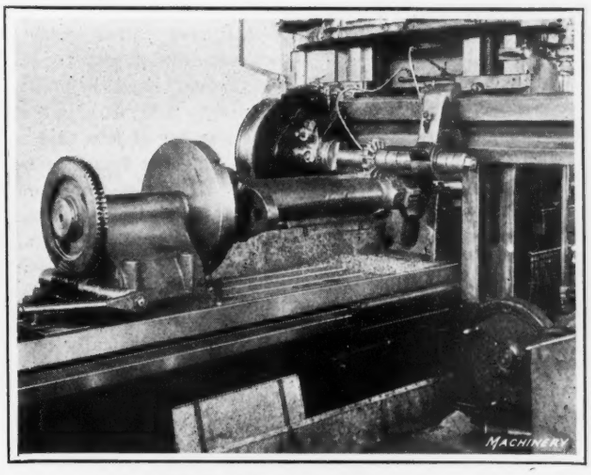


Fig. 22. Milling Clearances for Planer Tools that are to plane Outside of Circular Shape of Gun

Planing Operations on the Outside of the Gun Body

The first operation on the gun body is to plane the bottom and the side of the recoil slide, which must be planed true and parallel with the bore. This operation is performed in the manner which is indicated in Fig. 17.

As there are three different radii on the gun body which must be finished, but which cannot be machined in a lathe on account of the projections on the body, it is necessary to mill clearances for the planer tools which will form or plane the outside to the circular shape required. These clearances are milled as indicated in Fig. 22. The gun body is mounted in a fixture which can be rotated by means of a worm and worm-wheel. The milling cutter is brought down to the correct depth in the gun body, and the latter is then rotated, resulting in a groove being milled for the required distance around the gun body to provide the necessary clearance for the planing tools. The gun body, with the clearance grooves milled and set up in the planer ready for a planing operation, is shown in Fig. 20.

As mentioned, there are three different radii or steps to

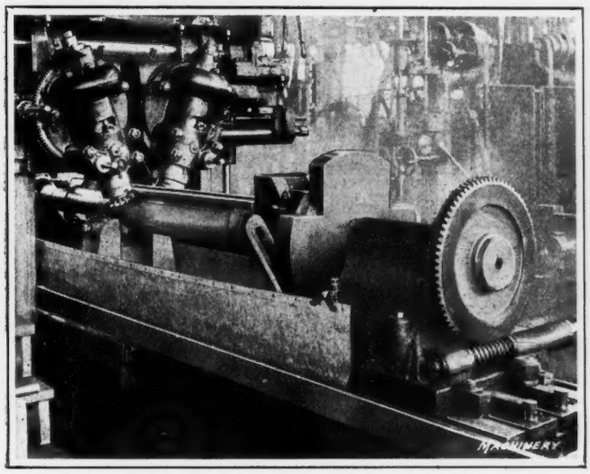


Fig. 23. Milling or under-cutting the Metal at Upper End of Recoil Slide

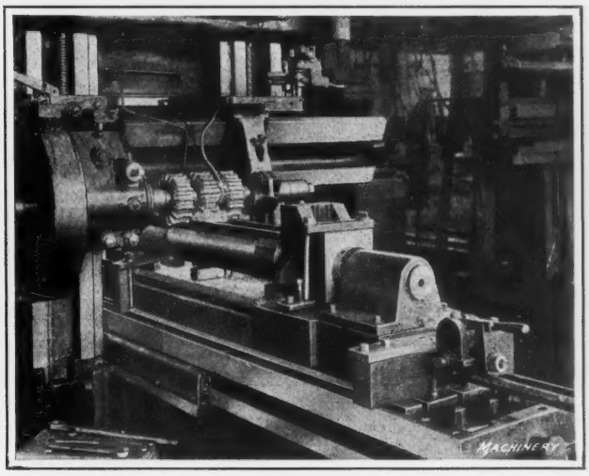


Fig. 24. Milling Three Steps between the Ways of the Recoil Slide

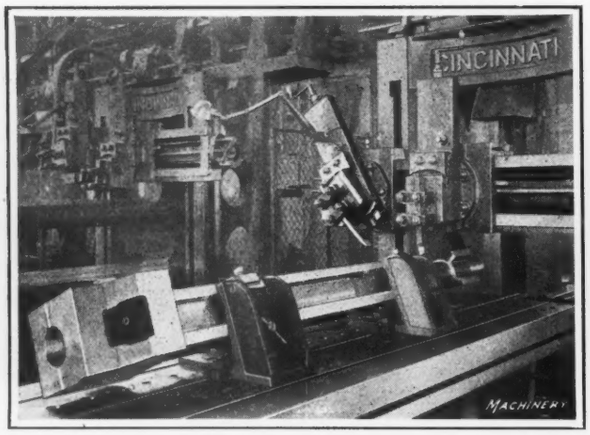


Fig. 25. Planing Fixture with Gun Body in Position for planing the Closing Spring Case Seat

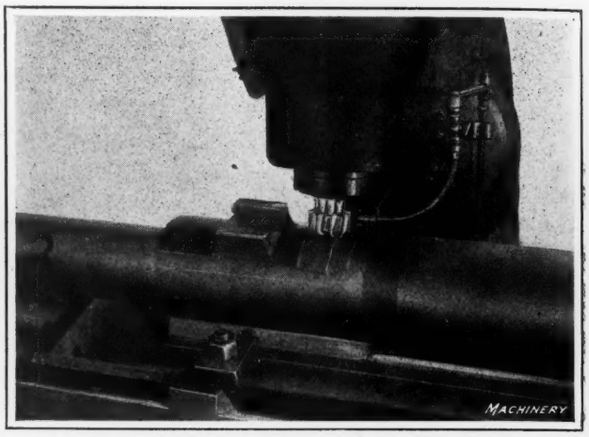


Fig. 26. Removing the Stock between the Recoil Cylinder Lugs by milling

be planed on the body, which is held in the planer on rotating centers, the planing being performed by turning the body by the worm and worm-wheel shown in Fig. 21; as the planing proceeds, this rotating of the body takes the place of the feed.

Fig. 23 shows the next operation, which is performed by milling. This is an under-cutting operation which removes the metal at the upper end of the recoil slides. The operation shown in Fig. 23 is the roughing cut. After this cut has been taken, the slide is finish-planed in a planer.

On the bottom of the gun, between the two slideways for the recoil slide, there are three diameters or radii corresponding to the three diameters which are planed on the upper side of the gun. These three steps between the ways of the recoil slide are finished by milling, as shown in Fig. 24. Three milling cutters are mounted on a single arbor, one cutter for each of the steps. The gun body is mounted in a special fixture which saves the time of removing and replacing cutters of different diameters for cutting each of the steps. The base of the fixture is clamped on the platen of the machine, but the upper part of it can be moved crosswise of the table, under the arbor and locked in three positions corresponding to the position of the three milling cutters. This fixture is shown in detail in the line illustration, Fig. 27.

Another planing fixture is illustrated in Fig. 25, which shows the gun body in position for planing the closing spring case seat. The fixture locates the gun body by the recoil slide ways, and hence insures the accurate location and angle of the spring case seat. Another interesting operation on the gun body is shown in Fig. 26. Here a milling cutter in a vertical milling machine removes the stock between the recoil cylinder lugs. So-called "cradle" or "rocking" fixtures are used for rotating the gun body while milling.

The succeeding article on making the U. S. 75-millimeter field gun will deal with operations on the clip; slotting the breech recess; boring fixtures; miscellaneous jigs and fixtures; and operations on the breech-block.

* * *

An investigation undertaken at the Ford Motor Co.'s shops at Detroit, for the purpose of ascertaining the amount of work that could be handled by cripples, according to the *Scientific American*, revealed the following interesting data: The number of jobs that could be filled by men who had lost both legs was found to be 670; by those who had lost one leg, 2637; by one-armed men, 715; and by those totally blind, 10. It was also estimated that 1743 of these jobs required but one day or less of training for the cripple; for 251 jobs, it required one to two weeks; for 534 jobs, from a month to a year; and for 43 jobs, from one to six years. About 18 per cent of the employes at the Ford plant are said to be cripples or physically below standard, although 85 per cent of this number are classed as fully efficient workmen. These figures are of great interest in connection with the efforts made to properly take care of disabled soldiers.

* * *

The British Government has recently completed an 8-inch oil-pipe line across Scotland. The line which was constructed under the supervision of an American naval unit consisting of experienced pipe-line men, was laid for the purpose of securing a continuous supply of fuel oil for the British Navy with a minimum risk of interference from enemy submarines. The rate at which fuel oil can be pumped through this pipe is estimated to be about 100 tons per hour.

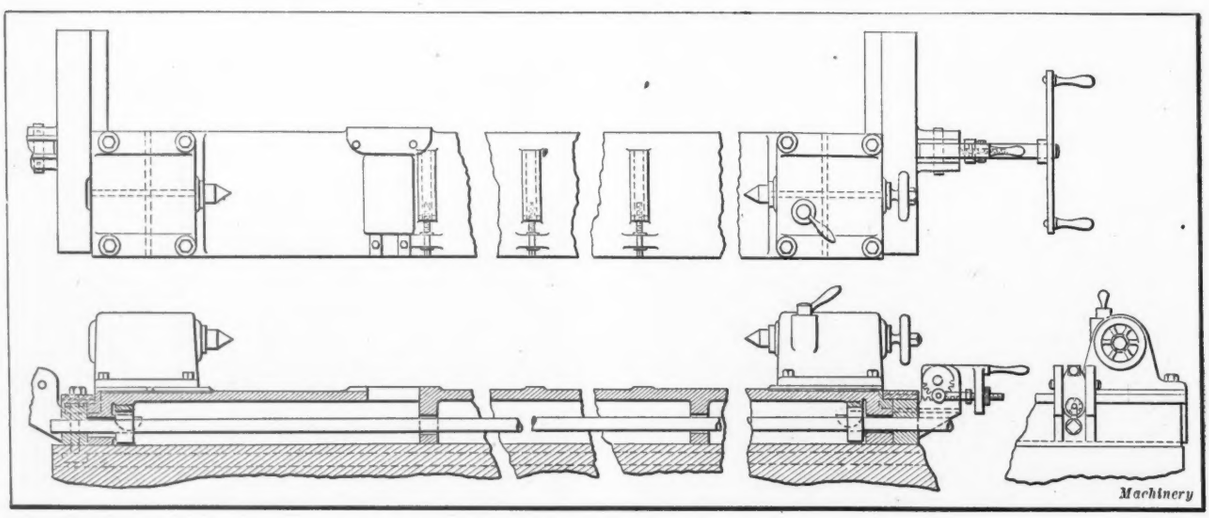
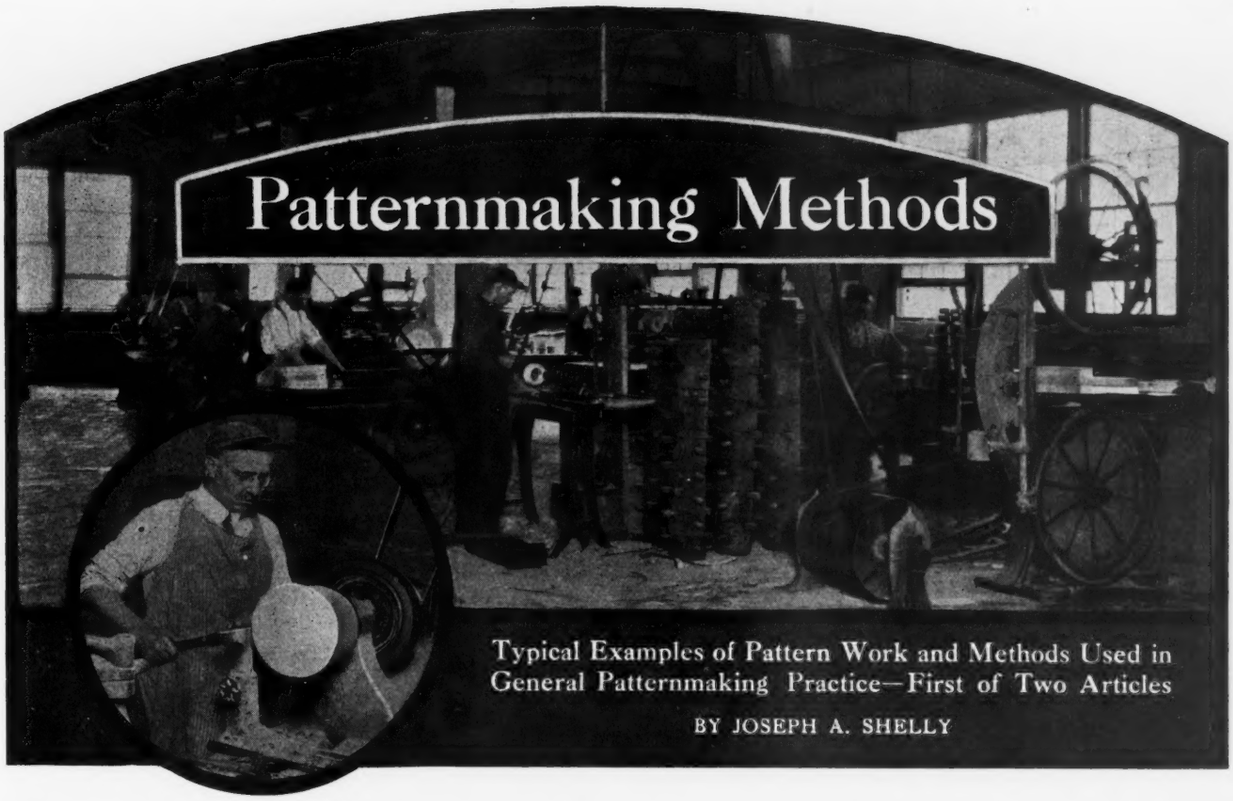


Fig. 27. Fixture used in Milling Operation shown in Fig. 24



Patternmaking Methods

Typical Examples of Pattern Work and Methods Used in General Patternmaking Practice—First of Two Articles

BY JOSEPH A. SHELLY

SMALL patterns are usually carved from solid pieces of some hard wood like mahogany, and this work requires a high degree of skill in the use of chisels and gages, as well as considerable patience. It is not practicable to part very small patterns, but the draft should always be arranged so that the molder can make his partings without trouble. There are a large number of patterns made that are complete models of the required casting and do not present any very difficult molding problems, but that do require considerable skill to produce economically. The provision of draft on small work is not so important as on larger pieces, and when the draw is but an inch or so, it may be ignored entirely unless there is a projection that must be coped, in which case it is advisable to leave as much draft as possible.

Lever Patterns

Lever patterns are what might be termed examples of simple pattern work, although sometimes they are very crooked and must be molded in three-part flasks. It was formerly the practice to carve small straight levers from a solid piece. A piece of stock of the proper thickness was first prepared, and the lever laid out as at *A*, Fig. 1, the bosses being carved from the solid after using the band saw to cut the pattern as near as possible to the lines, as at *B*. This is a very good method when the web tapers as at *C*, but to simplify matters many designers make the webs parallel and, as far as possible, of equal thickness so that a number of levers may be laid out at one time, as at *D*; the bosses, which are turned, are fastened in place with glue and nails. The centers must be laid out on both sides, and when the bosses are attached the lever is sawn on the band saw and finished either by hand or on the disk grinder. The corners, which are rounded, are finished by hand with a spokeshave or knife.

A handled lever *B*, Fig. 3, must be centered and the handle turned before it is sawn to shape, and it will have to be worked from the solid. If it is a bellcrank lever *E*, Fig. 1, the two pieces forming the web can best be joined with a corner lap joint, and if it is the type of double lever shown at *C*, Fig. 3, it will have to be parted to mold in a three-part flask. When levers are double and have a connecting piece as at *D*, Fig. 3, or when they have a circular section as at *E*, they should be made parted. When a number of levers are being laid out at one time, the bosses on the cope side will often be of different heights which will interfere

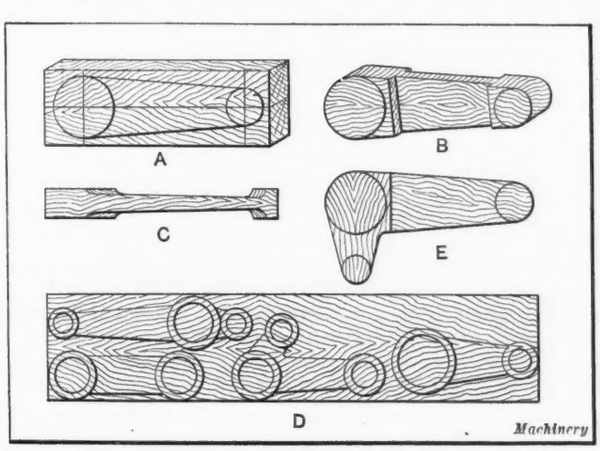


Fig. 1. Lever Patterns

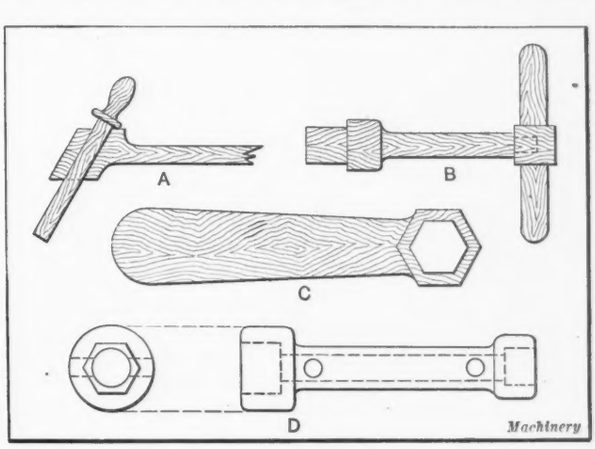


Fig. 2. Wrench Patterns

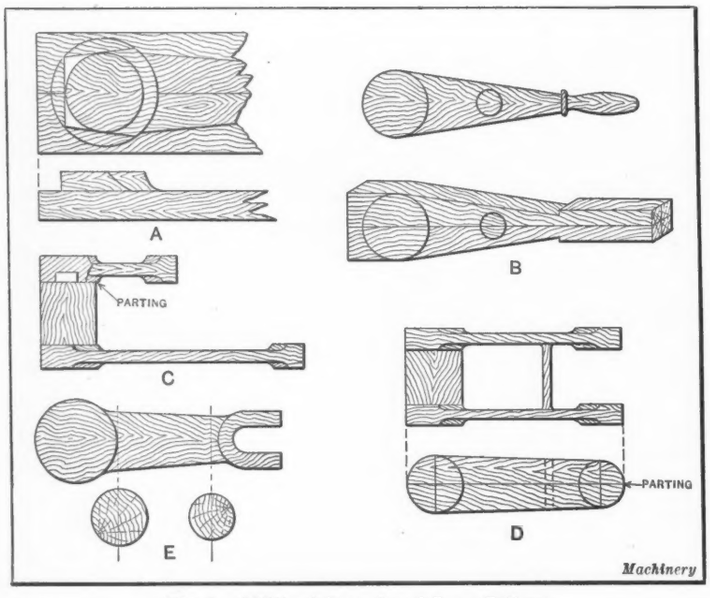


Fig. 3. Additional Examples of Lever Patterns

with the band-sawing; in such cases they will have to be put on afterward. To locate a filleted boss when there is not room to lay out the fillet diameter, it is squared at three points with a paring chisel, as at *A*, Fig. 3, and these flattened spots are set tangent with the boss circle. Levers should be sandpapered carefully to avoid distorting the bosses.

Wrench Patterns

Webbed and ribbed wrenches are made by working the space between the ribs to shape on each side down to the web (using a router to get the correct depth and a small outside-ground gage to make the fillets) before the outside and the jaws are cut and pared, as this makes it easier to hold the block in the vise. A Forstner bit is a good tool to bore away the stock before using the router, or it may be roughed out with a gage. A box wrench *C*, Fig. 2, should be cut to form and the handle pared to thickness before the nut opening is cut. The pattern should be laid out on both sides to give a little draft, and should first be bored, then pared with a chisel, and finished by rounding the corners.

Key-socket wrench patterns *B* are turned with the center part of the handle left square so that a fillet may be made in the corner where it joins the wrench shank. A pin is turned on the shank to fit a hole bored in the square part of the handle. The core-print is turned round and worked square or hexagonal, as may be required. Such a pattern will not, in most cases, be made to part.

Piston nut wrenches *D* are double-ended sockets designed to fit a different size at each end. As these nuts are quite large, the pattern may be parted and the core made to run from end to end and with side projections to make the holes for the cross-rod that is used to turn the wrench and nut.

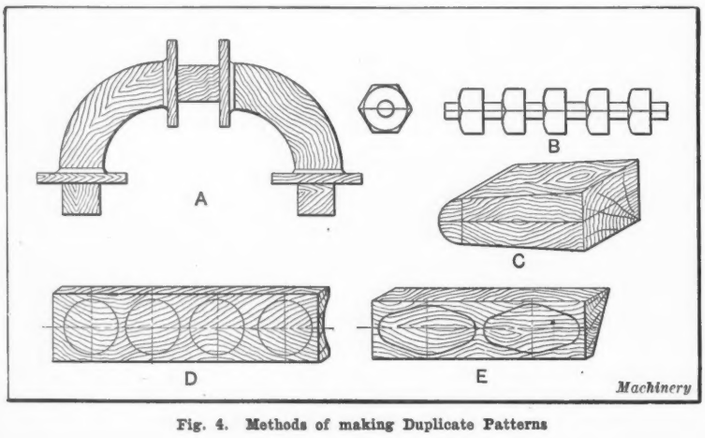


Fig. 4. Methods of making Duplicate Patterns

Patterns Requiring Small Cores

It sometimes happens that a core for a small piece is to extend through at an angle and there will be very little chance to make the core-print loose, in which case a hole may be bored the required size and at an angle through the pattern, and a core-print turned to fit it; this print should have a handle and a shoulder to stop it when it has reached the proper depth (see *A*, Fig. 2). It is pushed through the hole after the cope is lifted and is drawn out before drawing the pattern.

When a great many small holes are required in a thin piece it is always troublesome to put draft on them, but this may be overcome by boring the holes a little under size and reaming them with a tapered iron rod of suitable diameter, the rod being first heated sufficiently to char the wood slightly but not enough to cause it to burn. Small turned rings and other pieces designed to leave their own core should be turned with the grain of the wood parallel to the axis. It is easier to turn them this way and they can be sized more accurately and will draw better. Beeswax is used for making small fillets and for filling screw holes.

Making Duplicate Patterns

It is often desirable to have more than one pattern of small pieces that are to be cast in quantities, and many patterns require large numbers of pieces that are exactly alike. A little forethought will often enable such work to

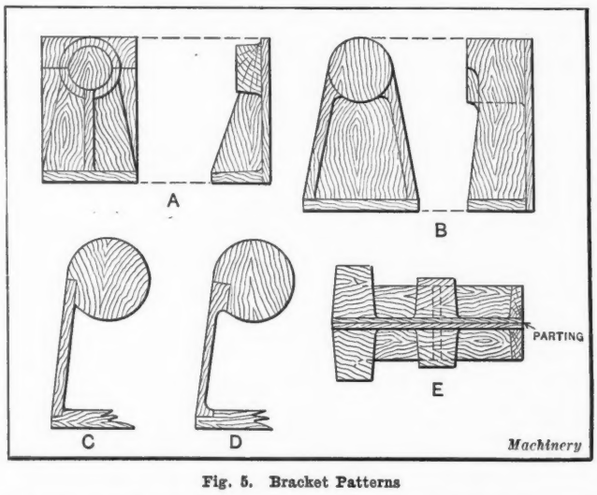


Fig. 5. Bracket Patterns

be done easily and quickly. A pair of small elbow patterns, *A*, Fig. 4, and a core-box can be made with very little more labor than would be required to make a single pattern, as the ell section is usually turned in four pieces and only two are used; the same is true of the core-box. Another illustration of this is a pattern *B* for casting a number of hexagonal nuts at one time. This is a parted pattern, and a single straight core runs from end to end.

Large numbers of tail-prints are frequently required and these are most easily made by making them in fairly wide units as at *C*, and then ripping them to the required thickness. These prints can be made alike by sanding them in a jig somewhat similar to that used for sanding gear teeth. When a number of facing pieces to fit an angle, or a number of bosses or hubs to fit a cylinder, are to be made, it is always quicker and more satisfactory to plane the stock to the angle or to fit the round on a long piece and then saw the duplicate parts to shape, as at *D* and *E*, instead of trying to make them singly. The stock can always be blocked level with the saw table. Bosses or hubs that are designed to fit cylindrical or spher-

ical shaped bodies should be turned, as they can be fitted by turning to a templet.

Bracket and Frame Patterns

Brackets are usually designed either with a central rib as at *A*, Fig. 5, or with ribs on the edges as at *B*. Bracket *A* is a simple form having a turned boss, and a foot, rib, and fillets in place ready for the band saw. When there is a low boss it should also be fitted in place and a strip the same height bradded to the web at the bottom to keep it level on the saw table. If the boss is to be loose, it should be doweled in place and taken off for the sawing operation. When the bracket is small and ribbed on each edge of the web, the boss and ribs can often be more economically made in a single piece as at *B*. This method provides a fillet where the rib connects with the boss, and a fillet connecting with the foot may also be provided for. When the bracket is large the ribs should be notched into the boss and also into the foot as at *C*, as this makes a stronger job and is easier to fit. To make the fillet on the rib, the latter is made thick enough for that purpose as at *D*. Brackets that are ribbed equally on both sides are usually parted through the center of the web as at *E*.

Chipping strips or other projections on the top of bracket feet or bosses that interfere with the draw should be made loose, and as these are usually small, the skewers should be made of nails or wire. The webs of frames are fastened in a number of different ways, and the ribbing is usually joined to hubs and bosses in the same manner as on brackets. Projections on the cope side of frames should be made loose,

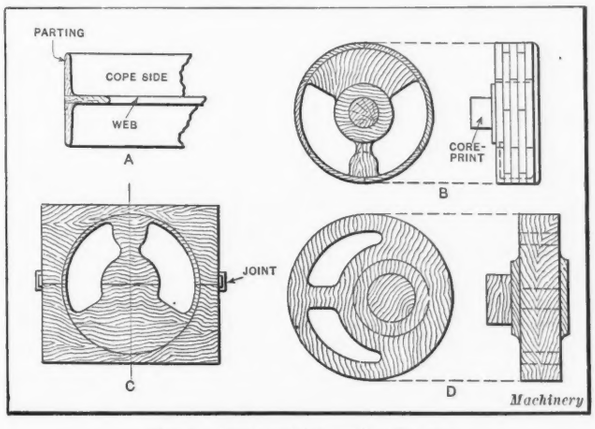


Fig. 6. Crank and Eccentric Patterns

but when ribbed on both sides, the ribs are made fast, as the molder carries his parting on the outside up to the bottom of the round corner of the cope rib, as at *A*, Fig. 6, and lifts the inside out. Instead of the draft running from the center of the web in both directions, it should extend straight from the top of the cope rib. Large hubs or bosses should, however, be made loose. Fly brackets and delivery frames in printing press work are without ribs, and frames of that type will stay straighter if fastened with mortise-and-tenoned joints; the same thing applies also to side frames.

Cranks and Eccentrics

Many cranks are levers, generally ribbed for greater strength, and they are handled in the manner previously described for levers, but the counterbalanced disk crank is another proposition. If it is large it should be built of segments and turned, and the inner part fitted to it as at *B*, Fig. 6. A fillet is turned where the flange connects with the web, so it is only necessary to leather-fillet the piece that is fitted. A small crank or a crank that is required in a hurry can be made economically of two pieces that have been laid out and band-sawed on the inside and glued together as at *C*. Dogs are used to hold the two pieces together, and the inside should be sandpapered before the web, which is a separate piece, is fastened in place. The outside should be

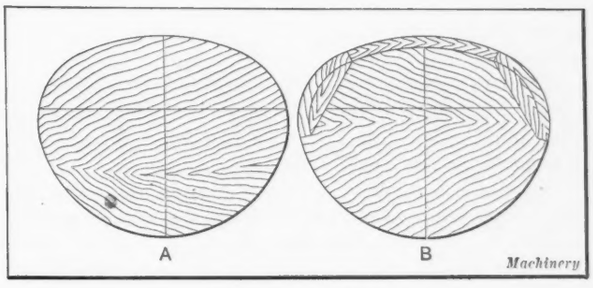


Fig. 7. Cam Patterns

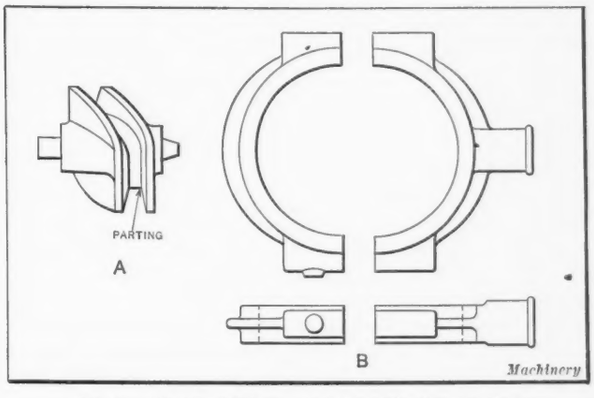


Fig. 8. (A) Cam Pattern. (B) Eccentric Strap Pattern

band-sawed after the inside is finished and the web is in place.

Eccentrics resemble cranks except that they do not have webs, and they may be handled in the same way, although they are usually heavier on the outside and the pattern is more substantial when made as at *D*, Fig. 6. A groove is sometimes required in the rim, in which case it would perhaps be better to turn a core-print on the outside and make the core in a part core-box.

Eccentric straps and caps may be built up, but small ones are usually carved from a piece of hard wood, as nothing is gained by making them of a number of pieces. If the valve stem sleeve is made so that it can be removed, a single pattern will do for both strap and cap. A strap pattern is shown at *B*, Fig. 8.

Cam Patterns

Most cams may be divided into two general types known as plate cams and cylinder cams. Plate cams may be plain or ribbed, and templets are frequently furnished the pattern-maker to give him the correct shape; to these he must add a finish and contraction allowance. This is done on small patterns, when the contraction is not much of a factor, by setting a pair of spring dividers an amount equal to the finish, and scribing with these around the templet. In making ribbed cams, the web should be laid out and worked to form first, as at *A*, Fig. 7, making it a trifle large so that a little draft may be given the outside of the ribs. The ribs are fitted in segment form, as at *B*; they are scribed from the web and sawn and perhaps spokeshaved a little before

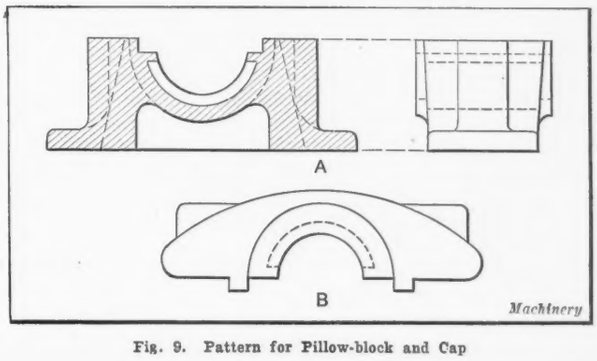


Fig. 9. Pattern for Pillow-block and Cap

the thickness is gaged. If the ribs are deep, the joints should be reinforced with a spline or a piece let in to cross the joints at the top.

The cylinder cam *A*, Fig. 8, owing to its form, must be parted to mold in a three-part flask. A paper templet to wind around the cylinder to form the proper helical groove is required, and is usually furnished by the drawing office. It is possible to make a band-saw parting on this type of pattern while it is in a block form and dowel the two pieces together before cutting it circular. This parting will not follow the parting line indicated, but will come between the two sides of the groove and will not always be central but it will do for molding purposes in this case. The templet should, however, be used to lay off the groove, irrespective of the parting.

Pillow-blocks and Caps

Pillow-blocks are made to mold either face down or on the side; in the first case they can leave their own cores, and if they are lightened by a recess in the bottom this can be coped as at *A*, Fig. 9, but when made in this way there will have to be an excessive amount of draft on the sides (see the end view), as the molder must cope down his parting, following, in a general way, the dotted lines at *A*; this will look like back draft as viewed from the end. This same pattern could be made to part through the center of the lug with the top and bottom cored, and this is very often done, but if there were two lugs on each side, this would not be practicable. Besides, it requires two core-prints and two boxes, which adds to the pattern cost. Small caps, with the exception of the end bosses, are best made of a solid piece, as the lugs and fillets can be carved quite easily. If the cap is large (see sketch *B*) leather fillets for the lugs or bosses can be more economically applied in the corners. If there is to be an oil-cup it can be fastened on to leave its own core unless the pillow-block is of the angular type; then the oil-cup will have to be set at an angle to bring the top level, and it will be cored and loosely doweled to the top with the dowel-pin holes bored parallel to the draw. If there are hinge lugs for a cover, these should be dovetailed to the oil-cup to be "picked in."

The next article on this subject will deal with patterns for linings, bushings, and boxes; steam chests, slide-valves, valve seats, and stems; pistons; cross-heads; pipes; air chambers; and engine beds.

* * *

COST OF AMERICAN AND BRITISH PATENT PROTECTION

In his presidential address delivered before the British Gas Industries, Sir Robert A. Hadfield stated that much credit is due Great Britain for having been the first to introduce a possible remuneration to inventors by means of patents. Even if the mercenary stimulus only be regarded, it can safely be said that the world at large has derived much benefit from the work of the patentee. Many of our intellectual men of modern times have conferred benefits of the highest order upon the world while they themselves have profited by their inventions. The rapid progress made in America has been largely due to the wise encouragement of patents. The small charge for patents in America does not mean that the patent does not afford the inventor adequate protection. Low fees stimulate patent activity and should be encouraged much more than in the past. At the present time, to obtain full protection within the British Empire, requires no less than forty separate patents, the total cost of which, for a small term of years—only fourteen in Great Britain and Ireland—is about $6500. The total charge with special government fees, agents' expenses, and patentee's expenses would probably increase the cost of one patent to about double this amount. The total charge for a patent in America is $35, which covers an area of more than 3,000,000 square miles and a population of 100,000,000.

SUBSTITUTES FOR TIN IN BEARING METALS AND SOLDERS

The Bureau of Standards, in its efforts to determine to what extent substitutes may be used for tin, calls attention to the limited supply and great demand for this metal, and mentions that it is imperative that steps be taken at once to eliminate all waste of tin and to use substitutes or reduce its use as far as possible and practicable in all alloys. It is pointed out that many specifications for bearing metals now in existence call for pure tin, and that a large saving of high grades of tin, such as Banca or Straits, could be brought about by allowing the use of second quality pig tin in making tin-base babbitt. Detrimental impurities could still be limited, but a maximum of 1 per cent of lead could be allowed. This would not be harmful to a tin-base or lead-base lining metal. There is no question but that the tin content could be reduced somewhat in all bearing alloys. Every possible saving should be effected. For those cases where genuine babbitt is now used and which require a very high grade of lining, alloys are suggested containing either of the combinations, 85 per cent tin, 10 per cent antimony, and 5 per cent copper; or 65 per cent tin, 3 to 6 per cent copper, and 28 to 30 per cent zinc.

Lead-base linings can be satisfactorily used in many cases where tin-base linings are now in use, and in fact the change has already been made in some shops, although the substitution should be more general. Several special types of lead-base linings, hardened with alkali earth, are reported to be giving very satisfactory service in the place of high tin babbitt. Two other alloys containing large percentages of lead and zinc have apparently been found to perform the same services which were required of tin-base linings in machine tool work. One of these alloys consists of 8 per cent tin, 8 per cent antimony, 4 per cent copper, and 80 per cent lead; and the other consists of 5 per cent tin, 7 per cent antimony, 2 per cent copper, 10 per cent lead, and 76 per cent zinc.

One way in which a lining metal can be saved is to use as thin a lining as is possible in order to maintain a high enough temperature during pouring to guarantee a firm bond and solid mass of metal. In place of a bronze bearing containing 80 per cent copper, 10 per cent tin, and 10 per cent lead, an addition of a small percentage of zinc or phosphor-copper and an increase of the lead content will result in a saving of at least 25 per cent of the tin ingredient.

There is very little excuse for using 50-50 solder for any purpose whatever, except for the appearance of the finished article. For hand soldering with an iron, a 45-55 solder will answer all requirements, and for most purposes a 40-60 solder will be satisfactory. Wiping solder, used by plumbers, should not contain over 37½ per cent tin, whereas some are now using 40-60.

Radiator manufacturers need not use solder above 40-60, and in most cases 35-65 will be found satisfactory. If the solder can be kept free from antimony, an even lower tin content can be used. The use of pure tin in radiator construction appears extravagant. If this is used merely for tinning purposes, preparatory to soldering, the eutectic alloy of tin and lead (which contains 63 per cent tin and 37 per cent lead) will be found to serve the purpose just as well. This should, in fact, be used generally where it is required to tin an article before soldering. Laboratory and manufacturing tests made by the bureau show the possibility of using cadmium as a substitute for tin in solder. No difficulty is anticipated in connection with the production of cadmium on a commercial basis at a price considerably less than tin, as soon as it has been demonstrated that its use for this purpose can be generally extended.

It has been found that aluminum, bronze, steel, brass, and various other metals can often be substituted in the manufacture of tin-alloy castings. Brass and bronze foundries should curtail the consumption of tin wherever possible and place restrictions upon its use, thereby limiting its use to the proved essential needs.

MILLING THREADS IN MALLEABLE FITTINGS

The Kol-Ben Wheel Co., Detroit, Mich., was recently investigating methods of cutting threads in male and female malleable iron fittings of the forms shown in Figs. 1 and 2. In these pieces there are quadruple threads of coarse lead, and the form of the work is such that the operations would be difficult to perform on many types of machines which are used for thread cutting. In order to obtain information concerning the possibilities of doing this work on thread milling machines with satisfactory results, the T. C. M. Mfg. Co., Hunterdon and First Sts., Harrison, N. J., was asked if it would be feasible to handle this job on the Thomson thread milling machines, and if it were, what production could be obtained. After giving the matter some consideration, it was found that a thread miller would do the work very satisfactorily, by the addition of a dial carrying four equally spaced trips to provide for disengaging the feed after each successive thread was cut, and also to provide for locating the work in the proper position relative to the single milling cutter with which the threads are milled, at the time that the half-nuts are engaged with the lead-screw.

Upon referring to the illustration of the machine, Fig. 3, it will be apparent that by locating the work and lead-screw, before taking each successive cut in positions varying from their relative positions at the previous setting by an angle of 90 degrees, provision will be made for milling the four threads required on these quadruple threaded parts. That the operation worked out satisfactorily is attested by the fact that on each of the parts shown in Figs. 1 and 2, the production obtained was 7½ pieces per hour, this rate being based upon the time taken from floor to floor, that is to say, in setting up the work and performing the thread milling operations. Those who have had experience with chasing threads on a lathe will at once see that this rate of production is substantially in excess of what it would be if the work were handled with an engine lathe equipment.

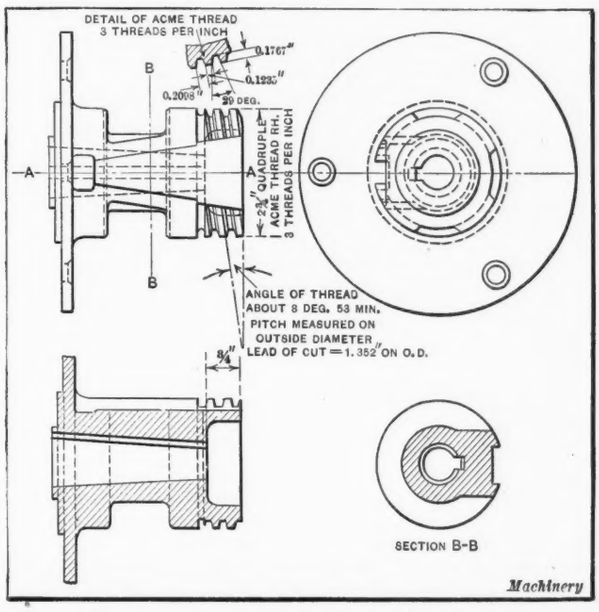


Fig. 1. Male Section of Malleable Fitting in which Threads are milled

The thread milling machine, which is shown in operation in Fig. 3, consists of a work-spindle driven by a worm and wheel from pulley *A*. This spindle carries a quadruple threaded lead-screw *B* which is engaged by a segment nut *C* controlled by a camshaft *D*. The work-spindle also carries a handwheel on which there are four knock-off pins *E*. When the milling of a thread is completed, one of these pins engages a trip-lever holding the camshaft in position and then the long spring *F* at the right-hand end of the machine rotates camshaft *D*, withdraws the cutter from work *G*, and

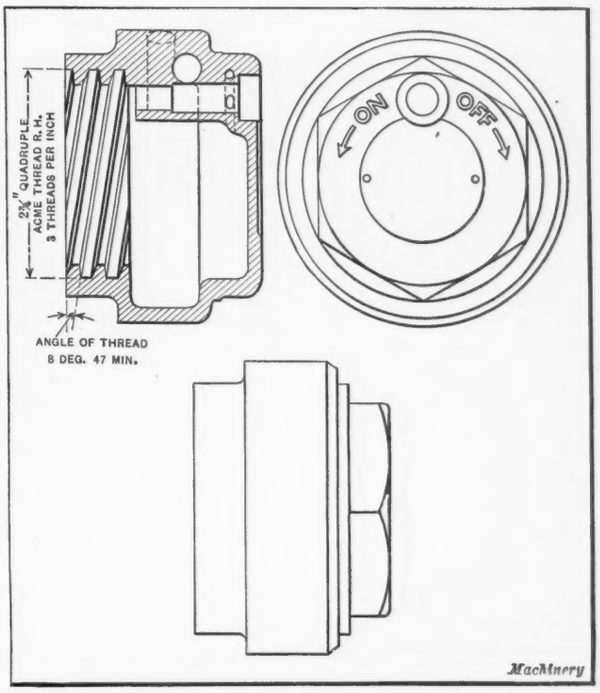


Fig. 2. Female Section of Malleable Fitting in which Threads are milled

lowers the segment nut from engagement with lead-screw *B*. The cutter-spindle is driven from pulley *H* through a chain gear *I*. This spindle is mounted in a bracket resting on a cam carried by camshaft *D*, and the cutter is brought back into position by a partial rotation of the camshaft by hand-lever *J* at the right-hand end of the machine.

One movement of the camshaft engages lead-nut *C* and also brings the cutter into position. Handwheel *E* serves to indicate by its position the correct place for engaging the lead-nut *C*, and it also affords a convenient means of pushing the spindle back lengthwise to the starting point after a cut has been taken. There are four numbered positions marked on the rim of the handwheel, so that the operator can cut four threads in succession and need not lose time by entering the cutter twice into one cut. Two of these machines were recently built, one for milling the internal threads in the hub caps, and the other for milling the external threads on the hubs. A feature of this method of threading is the quick withdrawal of the cutter at the end of the operation, which is essential in the case of the caps, as there is a projection close to the end of the thread. E. K. H.

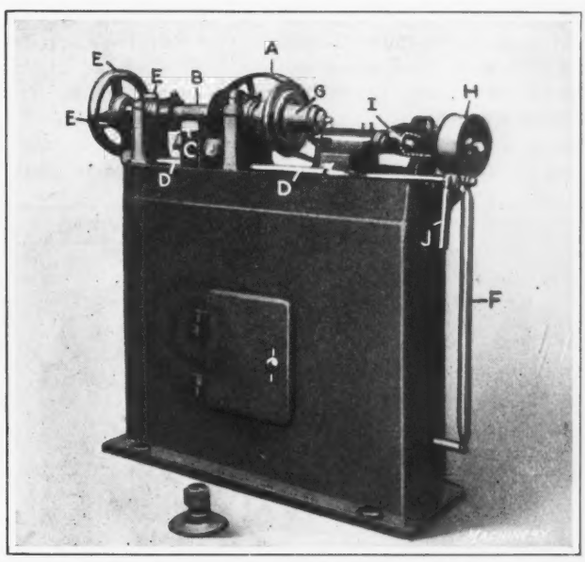
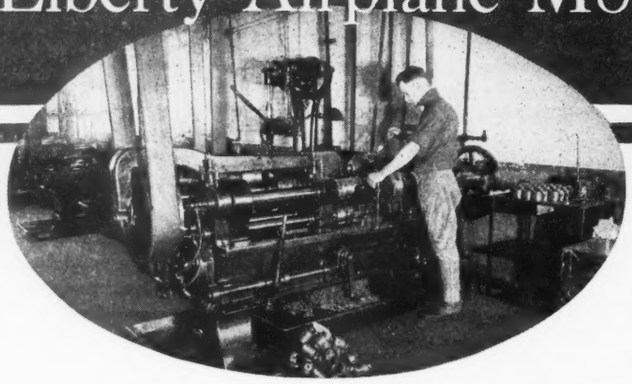


Fig. 3. Thomson Thread Milling Machine built by T. C. M. Mfg. Co. on which the Job is done

Making Liberty Airplane Motor Parts



Methods Employed in Machining Cylinder Inlet and Exhaust Elbows for the Liberty Airplane Motor at the Plant of the Packard Motor Car Company

IN the designing and subsequent development of the Liberty airplane motor, the designers had to deal not only with the problem of engine design but also with the problem of adapting its parts so far as practicable to quantity production, so that the productive capacities of standard machine tools could be utilized to their highest degree of efficiency. In cases where the required parts could not be readily machined with standard equipment, special tools and fixtures have been designed. In the present article, which describes the making of cylinder and inlet exhaust elbows, an idea may be gained of the special tools and fixtures required in the machining of parts for this class of work.

Cylinder Inlet and Exhaust Elbows

The cylinder inlet elbow, as the name implies, is an elbow which connects the manifold of the carburetor with the cylinder, and the exhaust elbow connects the cylinder with the exhaust pipe. In addition to forming angular connections for the exhaust pipe and inlet manifold, each of the elbows is provided with two bosses; one boss is machined to receive the stem of the valve which opens and closes either the inlet or exhaust port, as the case may be, and the other is machined to form a holder for the camshaft housing. Each cylinder requires two elbows—one exhaust and one inlet—making a total of twenty-four elbows for one motor. In this article a description is given of each operation performed on the elbows from the time the forgings are made until they are ready to be attached to the motor cylinders.

In Fig. 1 is shown the rough forgings, the one at the left being the forging for the exhaust elbow and the one at the right, that for the inlet. The number of operations required in finishing the inlet elbow is twenty-two, and the number required in finishing the exhaust elbow is twenty-five. This includes storing, counting, and all minor operations. The finished elbow weighs only 1¼ pound, 5 pounds of metal being removed from the forging in the performance of the various machining operations, the weight of the forging before machining being approximately 6½ pounds.

Fig. 2 shows the outside of the finished elbows. The one at the right is the inlet elbow. At *A* is the machined boss to which the camshaft housing is attached. *B* is the outside end of the boss through which the inlet valve stem passes. At *C* is the turned and faced end which is attached to the cylinder by the oxy-acetylene welding process, and at *D* is the end which is attached to the inlet manifold. In the illustration of the exhaust elbow, shown at the left, *E* is the machined boss to which the camshaft housing is attached, and *F* is the outside end of the boss through which the exhaust valve stem passes. At *G* is the turned and faced end which is attached to the cylinder by welding, and *H* is the machined end which connects with the exhaust pipe.

In Fig. 3 is shown the inside of the elbows. It will be seen that the hole through which the valve stem passes has been drilled in the inlet elbow, shown at the right, and also in the exhaust elbow, shown at the left. However, the practice of drilling these holes before the elbows are welded to the cylinders has been discontinued by the Packard Motor Car Co., these drilling operations now being performed after the elbows are welded to the cylinders. At the right is shown the inlet elbow, and it will be observed that the boss through which the inlet valve stem passes extends into the chamber of the elbow. Referring to the exhaust elbow at the left, it will be seen that the interior has been machined to conform to the contour of the outside of the forging. This machining operation will be described in a later paragraph.

Heat-treatment and Preliminary Preparation of Forgings

Before going to the machining department, the forgings are subjected to heat-treatment and sandblasting operations, which constitute the first five operations. The first operation is that of hardening, and consists of heating and quenching in oil. The second operation is, strictly speaking, an

Fig. 1. Rough Forgings of Cylinder Exhaust and Inlet Elbows

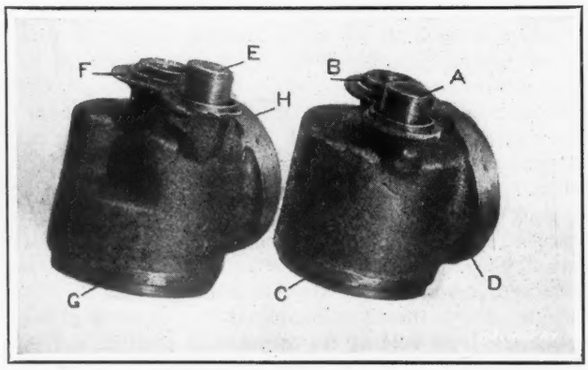


Fig. 2. Outside of Finished Cylinder Exhaust and Inlet Elbows

annealing operation and consists of reheating and drawing the forgings. The combined heat-treating operations are for the purpose of removing the forging strain in the metal, and to making it of a uniform hardness suitable for machining. The third operation is that of counting the forgings before being transferred to another department of the plant. The fourth operation is sandblasting, which is done in a sandblasting machine. The fifth operation is finish-sandblasting, which is performed by hand. This operation is performed on only a few of the forgings which were not thoroughly cleaned by the previous operation. The sandblasting is for the purpose of removing the scale from the forgings. The sixth operation is the counting of the forgings, and the seventh is storing.

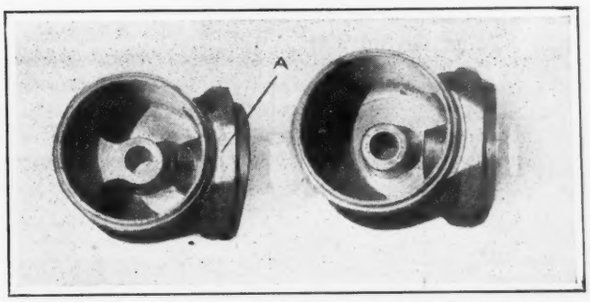


Fig. 3. Interior View of Finished Cylinder Exhaust and Inlet Elbows

Machining Cylinder Inlet Elbow

While the making of cylinder inlet and exhaust elbows involves many interesting operations, particular attention is called to the machining operations performed on the New Britain multiple-spindle automatic machines. In Fig. 4 is shown the forging of the inlet elbows after each successive machining operation from the eighth to the fourteenth, inclusive. These are the principal machining operations in making the inlet elbows; several of the minor operations which are not shown will be described in the sequence of operations.

Drilling Inlet Elbow Forging

The eighth operation consists of drilling the 1¼-inch hole preparatory to rough-drilling the 2½-inch hole in the cylinder end of the forging. This operation is performed on a Baker drilling machine equipped with a 1¼-inch drill, and a gage is used to determine the correct depth of hole.

Rough-drilling Cylinder End of Inlet Elbow

The ninth machining operation is performed on a Baker drilling machine and consists of rough-drilling a 2⅜-inch hole with a regular drill to the same depth as the 1¼-inch hole drilled in the previous operation. A hollow drill is then used to rough out the stock around the inside hub. A special drill jig is used to hold the forging during this operation, and gages are used to test the accuracy of the work, one being used to gage the depth to the end of the inside hub and one to gage the depth around the inside hub.

Finishing Operations on New Britain Four-spindle Automatic

A New Britain four-spindle automatic chucking machine is employed to finish the hole, the inside hub, and to face and turn the end, as indicated by the tenth operation, Fig. 4. In Fig. 5 is shown the tool equipment of each spindle of the New Britain machine for performing this operation. The work is held in the chuck jaws *A*; the tools in the spindle head simultaneously rough-turn the surface at *B*, rough-face the end at *C*, and tool *D* rough-bores the inside of the elbow at *E* to about half the depth of the hole, and faces the end of the inside hub at *F*. The second spindle finish-faces and chamfers the end at *C* and rough-bores and rough-faces the inside of the elbow forging around the valve stem boss. The third spindle finish-turns the flange at *H* and finish-faces the inside of the forging. The fourth spindle finish-bores the interior of the forgings, finish-faces and chamfers the flange at *H*, and also finish-turns the surface which was rough-turned at *B* by the first spindle. The work is inspected after this operation by using a set of gages which consists of one plug gage for gaging the inside diameter, a snap gage for the inside hub, a gage for the distance from the face of the hole to the back of the rough forging, a gage for the depth from the face of the hole to the inside hub, a gage for the depth around the inside hole, a snap gage for the outside diameter, a caliper gage for gaging the thickness of the bottom wall, and a gage for the depth of the flange.

The eleventh operation consists simply of rough-spot-facing the valve stem boss in a drilling machine. No gages are required for this operation.

Machining Valve Stem Bosses

The twelfth operation consists of facing and recessing the valve stem boss as indicated in Fig. 4. This is done in a New Britain four-spindle automatic chucking machine, equipped with special tools and a chuck for holding and accurately

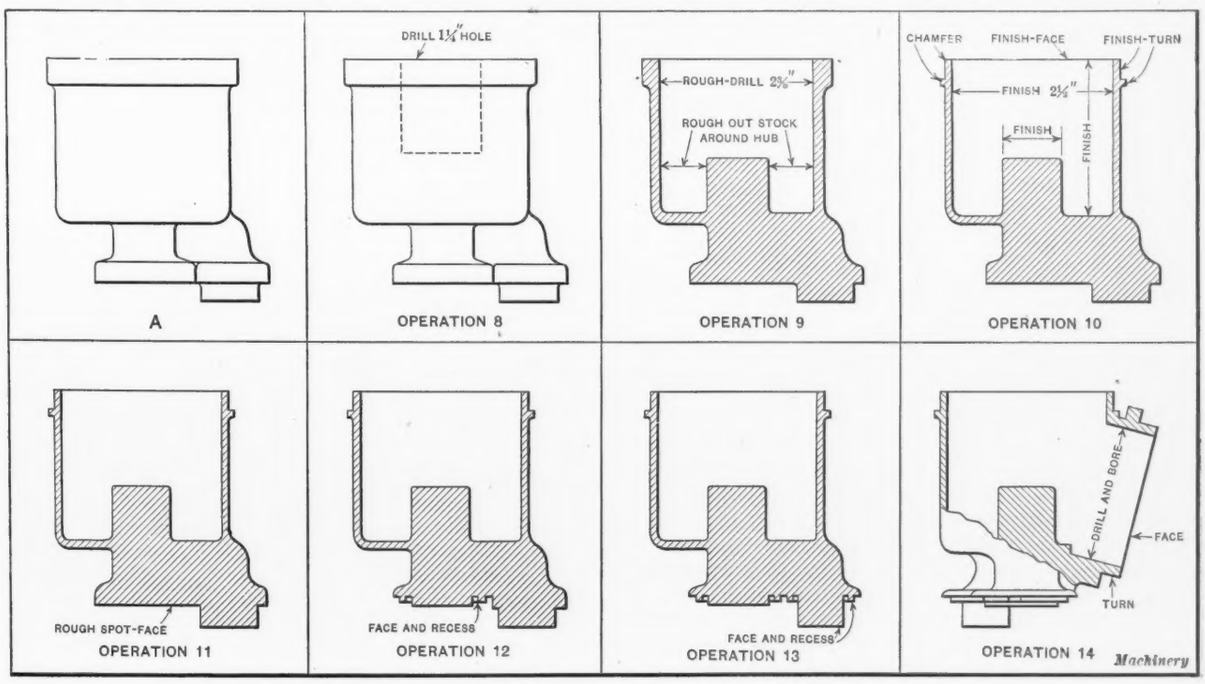


Fig. 4. Principal Machining Operations performed on Inlet Elbow

locating the work. The tooling of the four spindles is shown in Fig. 6, and the special chuck for holding the work is shown in Fig. 8. In Fig. 8, *A* represents the work which is located in the chuck by placing the finished cylinder end in a locating block *B*. This method of locating the work brings the axis of the machine spindle and the previously machined surfaces into alignment. It also acts as a stop and insures the turning of each boss to the same depth. The work is securely held in place by jaws *C*. It will be seen that the jaws are tightened by two studs *D*. Latches *E* provide a means of quickly tightening the jaws upon the work with a

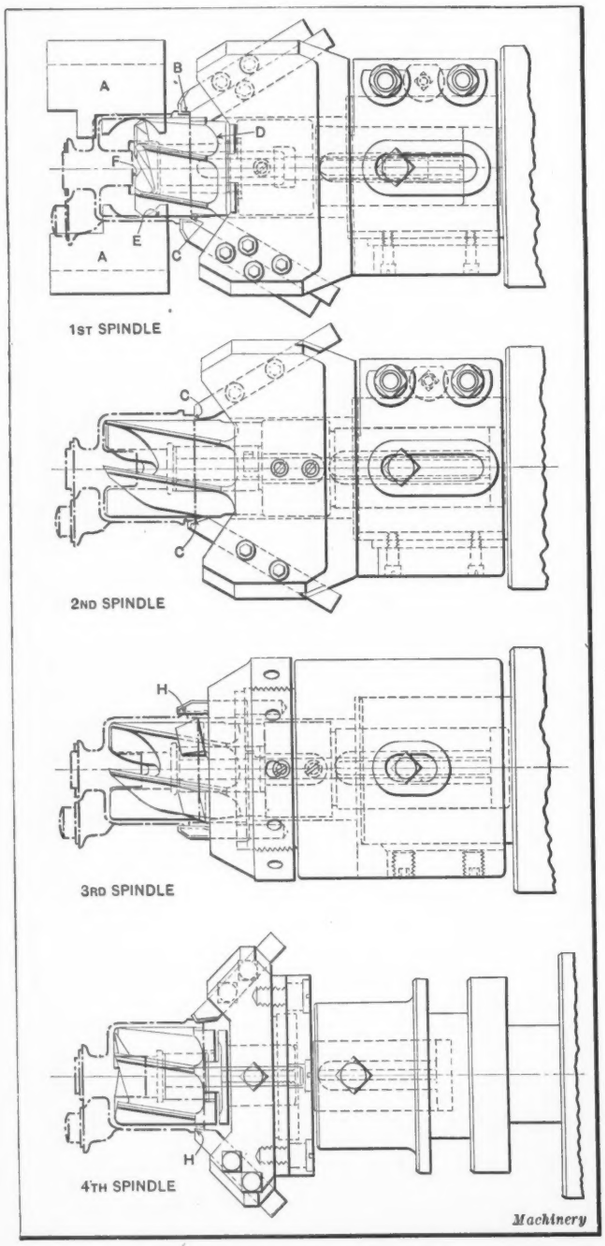


Fig. 5. Special Tool Equipment of New Britain Four-spindle Automatic Chucking Machine used in the Tenth Machining Operation on the Inlet Elbows

minimum number of turns of studs *D*. The bushing *F* for steadying the tool *G* is also incorporated in the chuck body. A plunger *H* ejects the work from the locating block *B* when the machining operations are completed.

To remove the work *A* from the chuck, studs *D* are loosened a sufficient amount to allow the latches *E* to be swung around on the studs *I* until they clear the shoulders on the studs *D*. The compression springs *J* then force the jaws *C* out until the bottoms of the counterbored holes at *K* come into contact with the shoulders on the studs *D*. The plunger *H* is then used to force the work from the block *B*.

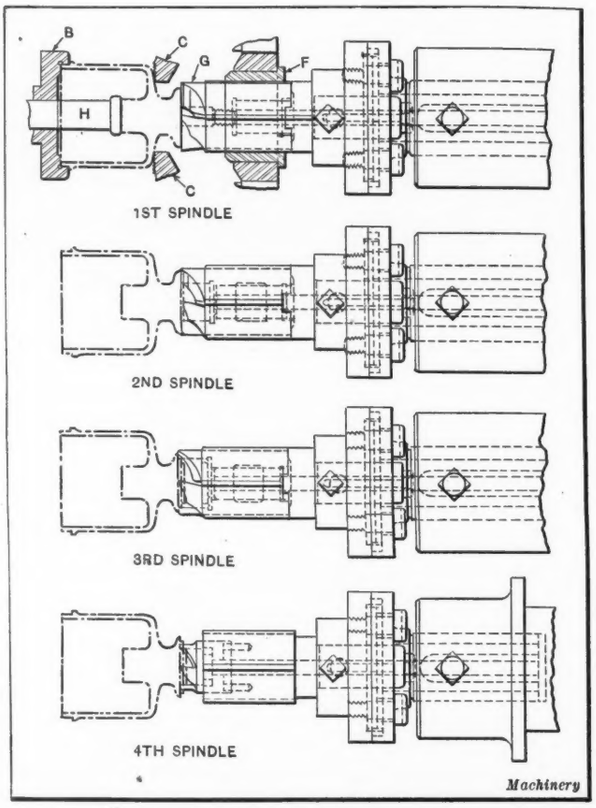


Fig. 6. Tool Equipment of New Britain Four-spindle Automatic Machine employed in machining Valve Stem Bosses of Cylinder Elbows

Referring to Fig. 6, it will be seen that the first spindle performs a facing operation. Sections of the chuck and bushing for steadying the tool are here designated by the same reference letters as those used in the assembled view of the chuck, Fig. 8. The second spindle, Fig. 6, finish-turns and finish-faces the first shoulder of the boss as shown. The third spindle finish-turns and finish-faces the flange of the boss, and the fourth spindle recesses the boss. The section of the finished boss can be more clearly seen by referring to the twelfth operation, Fig. 4. For gaging the work after this operation, only two gages are required; one for gaging the distance from the face of the 2½-inch hole to the outer flange of the valve stem boss, and one for gaging the height from the flange to the top of the boss.

Machining Camshaft Housing Boss

A New Britain four-spindle automatic chucking machine, shown in Fig. 7, equipped with special tools and a fixture for holding the work, is used for machining the camshaft housing boss. In Fig. 9 is shown the tool equipment and

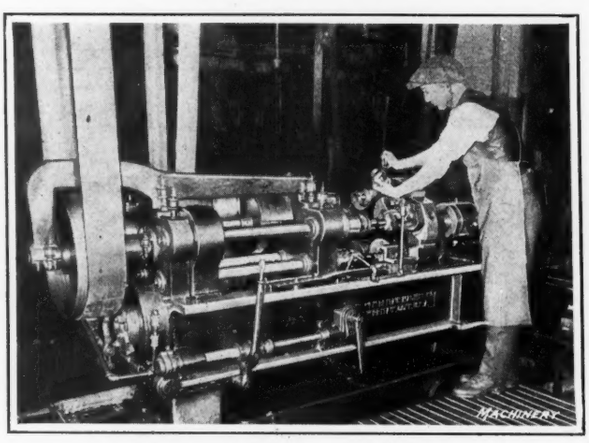


Fig. 7. New Britain Four-spindle Automatic Chucking Machine equipped for machining Camshaft Housing Boss

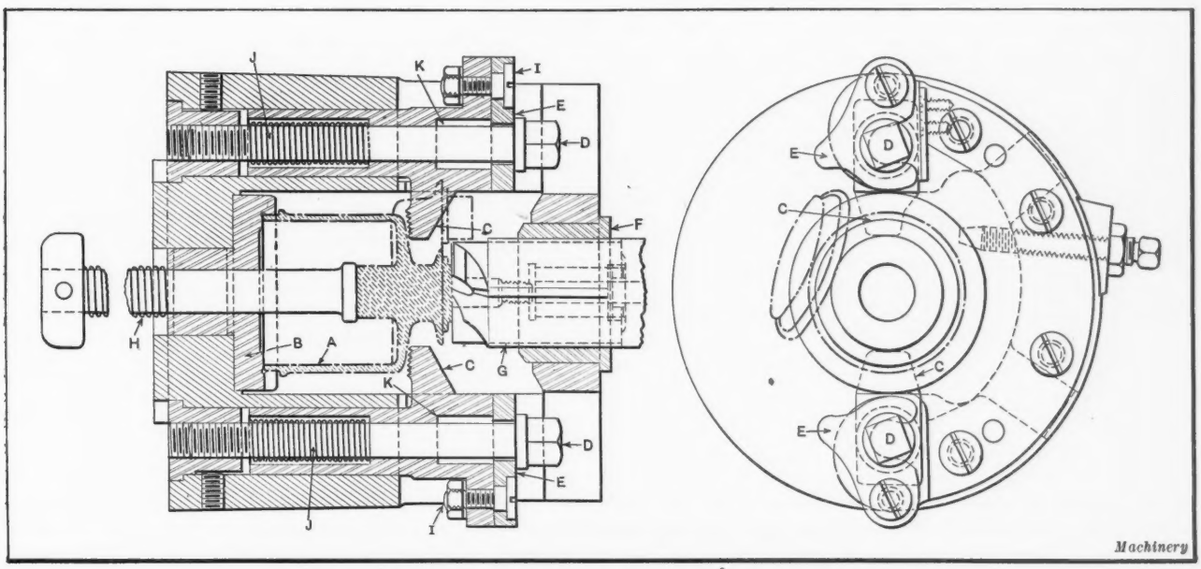


Fig. 8. Special Chuck used in performing Machining Operations indicated in Fig. 6

fixtures employed. The first spindle rough-turns the boss; the second spindle finish-faces the outer flange and finish-turns the inner one; the third spindle finish-faces the inner flange and finish-turns the boss; and the fourth spindle forms the recess as shown in the thirteenth operation, Fig. 4. No gages are required for this operation.

Machining Manifold Connection

The machining of the manifold connection is done on a five-spindle New Britain automatic chucking machine, and consists of drilling and boring an angular hole in the side of the elbow, and turning and facing the flange, as shown in the fourteenth operation, Fig. 4. The tool equipment and fixture for holding the work is shown in Fig. 11. Two views are shown of the fixture for holding the work, and it will be seen that a locating block is used to locate the piece in the proper angular position in reference to the machine spindle. By screwing in the stud *A*, the work is firmly held in the jaws of the fixture. The first spindle drills the ⅞-inch hole through the solid portion of the forging as indicated. The second spindle carries a drill which enlarges the ⅞-inch hole to 1½ inch, and the tools held in the spindle head rough-turn and rough-face the flange and rough-turn the end as shown. The third spindle enlarges the 1½-inch hole to 1⅞ inch, rough-faces the end of the boss, and finish-turns the outside of the flange. The fourth spindle rough-bores the hole preparatory to finish-reaming. The fifth spindle finishes the inside of the hole, finish-faces and finish-turns the end of the boss, and finish-faces the flange. The gages for this operation consist of one plug gage, one snap gage for gaging the outside diameter, a gage for gaging the angle, a gage for checking the dimension from the flange to the large hole, a gage for the height of the angular hole, a gage for the depth of the flange, and a gage for the angular location in relation to the camshaft housing boss.

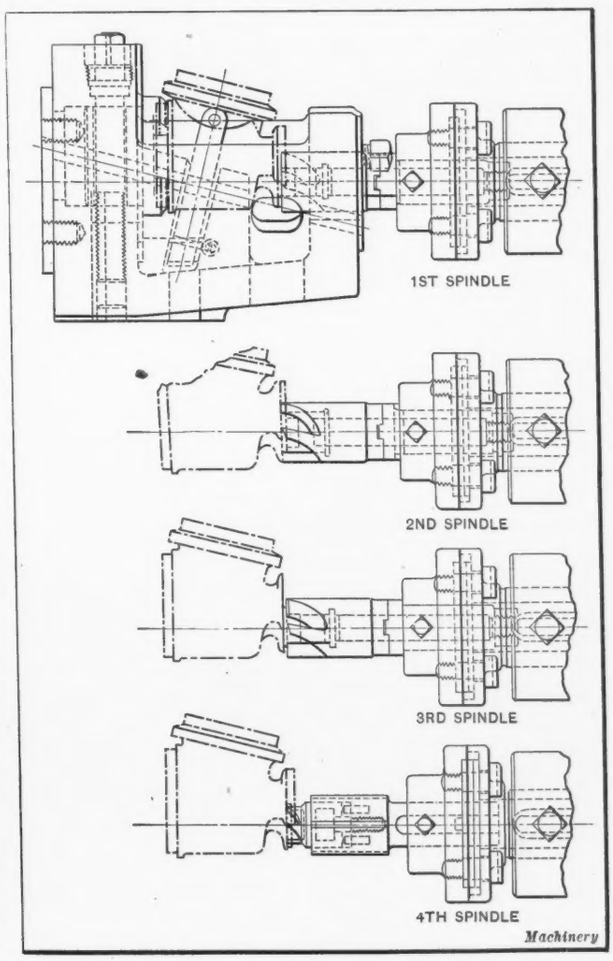


Fig. 9. Tool Equipment of Machine shown in Fig. 7

Milling Operations on Elbow

Although the fourteenth operation completes the more important machine work on the inlet elbow, there are several other operations performed before the piece is finished. The fifteenth operation consists of milling the flange of the camshaft housing boss to provide a clearance for the cylinder water jacket. A Briggs milling machine with a special milling fixture is employed for this work. A standard 1⅜-inch concave milling cutter is used and a gage is provided for gaging the width of the milled flange.

The sixteenth operation is milling a ¼-inch slot through the web between the flange of the angular hole and the flange of the valve stem boss. This is done on a hand milling machine equipped with a milling fixture for holding the elbow. No gages are required for this operation. The seventeenth operation is the drilling of a ⅜-inch hole through the web of the camshaft housing boss just below the flange. This is done simply to remove excess metal. The eighteenth operation is the milling of the flange on the bottom of the angular hole as shown at *A*, Fig. 3. In this operation only a small amount of metal is removed, the purpose being to facilitate the welding operation. A hand milling machine, provided with a special fixture, is employed, and a gage is used to gage the depth of the milled surface from the face of the

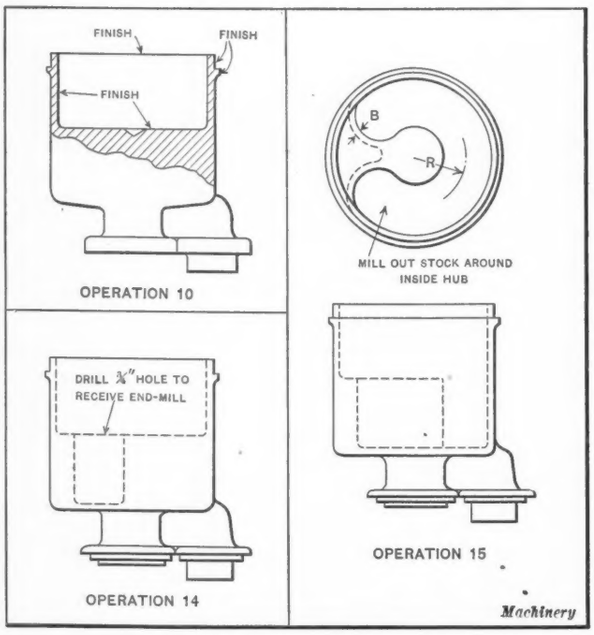


Fig. 10. Four Principal Machining Operations on Exhaust Elbow which differ from those performed on the Inlet Elbow

2½-inch hole. In the nineteenth operation the burrs left by the previous operations are removed by holding the forgings in a vise and using a file, or in some cases an emery wheel. The twentieth operation is washing the pieces in "Oakite." The twenty-first operation is the inspection and counting of the finished elbows, and the twenty-second operation is storing the finished elbows.

Making Exhaust Cylinder Elbow

Attention has been called to the fact that the only difference between the exhaust and inlet elbow forgings is the shape of the body. This can be seen by referring to Fig. 2. In order to produce a finished exhaust elbow having the sides of the body of a uniform thickness at all points, it is evident that special machining operations must be performed. By referring to the interior view of the exhaust elbow, Fig. 3, it will be seen that there is no boss on the inside, but a continuous projection from one side instead, so that the tenth operation finishes the bottom of the hole only to the top of this projection, after which a special milling operation is required for milling out the inside recess.

Aside from these special operations, the machining operations on the exhaust elbow are the same as those for the inlet. Therefore only such operations as are different from the ones previously mentioned will be described. In Fig. 10 are shown the special operations performed on the exhaust elbow. The operations from the first to the eighth, inclusive, are the same as for the inlet elbow. The ninth operation consists of rough-drilling the 2½-inch hole to 2⅝ inches in diameter. For this operation a Baker drilling machine equipped with a special drill jig is employed and a gage is used to determine the accuracy of the work. The tenth operation is finishing the 2½-inch hole and facing and turning the cylinder end of the elbow as indicated in Fig. 10. These operations are performed on a New Britain four-spindle chucking machine, the tool equipment of which is shown in Fig. 12. The first spindle is equipped with tools for rough-turning, rough-facing, and rough-boring to about half the depth of the hole, and spot-drilling the bottom of the hole with a drill in the center of the tool, as indicated. The second spindle finish-faces and chamfers the end and rough-bores and finish-faces the inside as shown. The third spindle finish-turns the flange, and the fourth spindle finish-bores, finish-faces, and chamfers the flange and also finish-turns the outside of the end.

In the eleventh operation the valve stem boss is rough-spot-faced in a drilling machine, a special fixture being used to hold the forging. In the twelfth operation the valve stem boss is faced and recessed, the operation being the same as the twelfth operation for the inlet elbow. The thirteenth operation—facing and recessing the camshaft housing boss—is the same as for the inlet elbow. The fourteenth operation is the drilling of a ¾-inch hole to provide a recess for starting the end-mill in the operation of removing the stock around the inside boss.

The milling out of the stock around the inside hub, as indicated by the fifteenth operation, Fig. 10, requires a special milling fixture as shown in Fig. 13. This fixture is attached to a Cincinnati milling machine, and a special end-mill is used to form the recess. As will be seen in the illustration, the work *A* is located in the block *B*, being rigidly clamped in place by the piece *C*, which is forced into contact with the valve stem boss by means of a handwheel attached to *D*. The table of the milling machine is set in such a position that the center of the end-mill is at a distance from the center of the forging equal to *R*, as shown in Fig. 10. The end-mill is inserted in the hole previously drilled in the fourteenth operation, and the part of the fixture in which the forging is held is rotated a sufficient distance to mill out the required recess. The gages used to determine the accuracy of this operation consist of one gage for gaging the diameter of the inside hub, one for the depth of recess, and a caliper gage for the thickness of the wall as indicated at *B*.

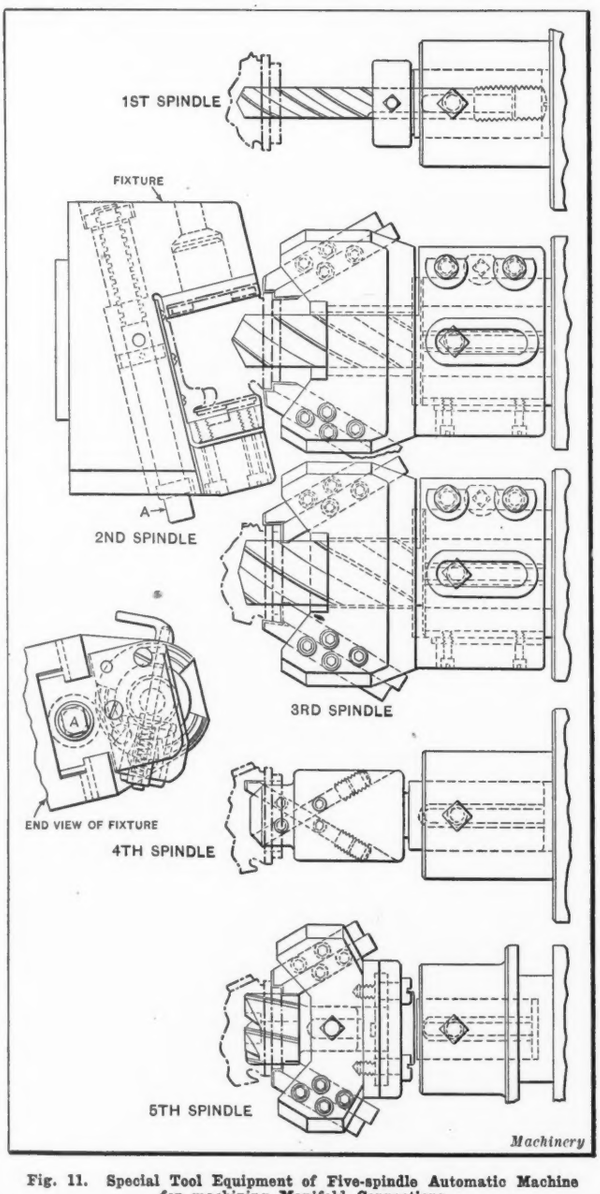


Fig. 11. Special Tool Equipment of Five-spindle Automatic Machine for machining Manifold Connections

The remaining operations, from the sixteenth to the twenty-fifth, inclusive, are the same as for the inlet elbow, with the exception of the milling operation on the inside hub, which is accomplished on a hand milling machine, and consists of simply rounding the edge of the inside hub.

While the machining of the elbows may seem to require a greater degree of accuracy than would at first appear necessary for so simple an element, a little study in motor design will reveal the necessity for machining these parts accurately. First it must be remembered that the elbows are welded to the motor cylinders and that the valve stems that open and close the inlet and exhaust ports pass through the elbows. These valves are operated by a camshaft which extends nearly the full length of the motor. The cams are covered by housings attached to the elbows. Therefore, in order to make it possible for the parts to be assembled easily and properly in their correct positions, it is necessary that they be accurately machined to within close limits. It is necessary to machine the forgings to a uniform wall thickness and to an unusual shape because of the requirements for uniform heat radiation throughout the forging and properly formed contours to facilitate the passage of the gases.

Production

The net production per day of exhaust and inlet elbows in the Packard Motor Car Co.'s plant averages 1450 elbows. This production is based on a twenty-hour day of two shifts, working ten hours per shift. The net production mentioned

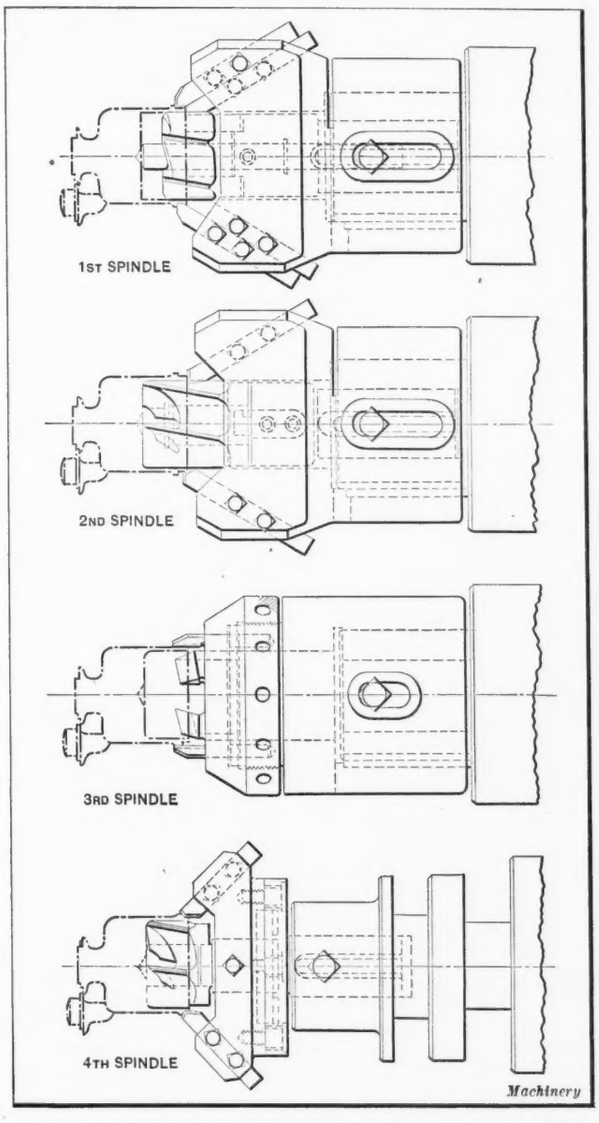


Fig. 12. Special Tool Equipment employed in finishing Cylinder End of Exhaust Elbows

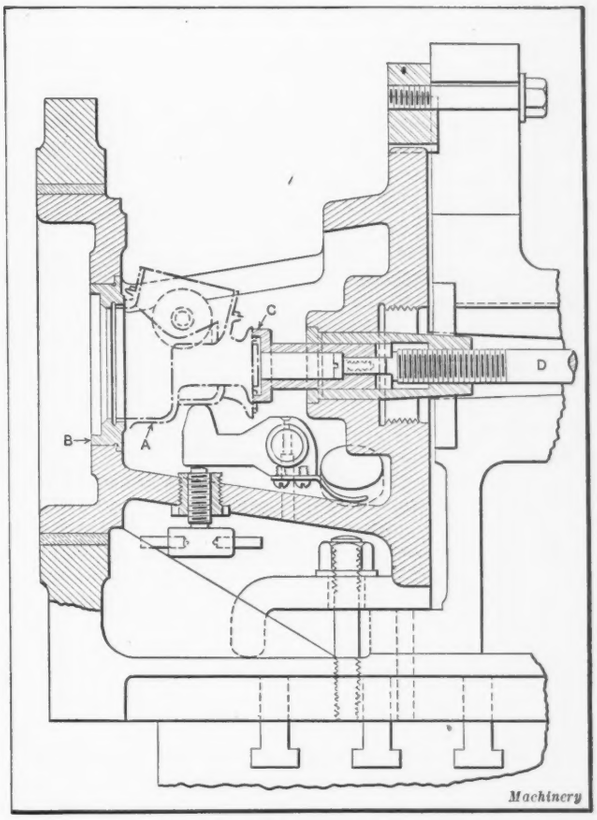


Fig. 13. Special Milling Fixture designed for milling Recess in Exhaust Elbows

is equivalent to the equipment required for the production of about 50 motors, and 200 extra parts to be shipped as service parts. By the net production is meant the number of pieces which are inspected and finally approved.

MACHINERY is indebted to R. Peele, mechanical engineer in the Production Department of the Packard Motor Car Co., for his assistance in obtaining the information required in the preparation of this article.

* * *

JUNIOR SECTION OF THE UNITED STATES EMPLOYMENT SERVICE

The Junior Section of the United States Employment Service has been created for the purpose of extending vocational guidance to the nation's youth as it enters into the industrial life of our country. The number of boys and girls who become wage earners increases each year, and in the majority of cases their immature minds and partly developed faculties need proper direction and assistance in selecting the work for which they are adapted. A word of counsel and guidance at this time, or the lack of it, may make or mar their future. The Junior Section of the department which has been created will have councilors in local offices who will have as their sole duty the placement of boys and girls between the ages of 16 and 21. In the general instructions to Junior councilors which have been prepared at the administrative headquarters of the Employment Service the following are outlined as specific duties: To influence boys and girls to remain in school as long as possible; to aid in giving the right start for those who have had to leave school to go to work; to arouse the ambitions of boys and girls to fit themselves for definite life careers; to direct youth who are employed toward some form of trade, technical, or business school for special training; to promote the needed opportunities for vocational education in the community; to follow up all applicants in their training and at their work to see that they have the best available advantages of study and labor. By this means it should be possible to aid boys and girls in selecting suitable and congenial work.

STORING OF GAGES AND TOOLS

By AUGUST MARX, Vice-president, G. A. Gray Co., Cincinnati, Ohio

As there are probably many other shops confronted by the same difficulty that was experienced at the G. A. Gray Co.'s plant at Cincinnati, Ohio, the photographs and the following description should be of general interest. The old tool-room, having fixed wooden shelves and bulky gage racks, which is a common type of tool-room lay-out, gradually became overcrowded, due to the continued increase in the number of special tools, jigs, and fixtures. This fact and the abnormally high wages commanded by skilled labor made it imperative that the amount of time spent in waiting at the tool-room be cut to a minimum. It was decided, therefore, to rearrange and re-equip the tool-room to meet these new conditions. With the assistance of the representative furnished by the manufacturers of the metallic equipment which was adopted, the problem was satisfactorily solved.

The accompanying illustrations show views of two sections of the rearranged room. The tools and jigs were first separated into three classes: active tools, special tools used less frequently, and tools used on obsolete parts which were rarely called for. The idea, of course, was to place the tools and fixtures most frequently called for in the most convenient location and nearest to the tool counter. Each class was then subdivided, the jigs, bushings, drills, taps, reamers, mandrels, etc., of each subdivision being rearranged according to size.

Fig. 1. Steel Shelving Equipment with Special Compartment arranged for Convenience in keeping Snap Gages and Similar Tools

As every man in a tool-room is familiar with the different kinds of tools, it was not necessary to use the name of the tool on the label; the only labels used were those that pertained to the different sizes of the tool. Snap gages and similar tools were hung on the sides of iron-shod vertical boards that are capable of sliding in either direction in metal guides. This arrangement is clearly shown in Fig. 1, and, as can be readily seen, it saves a great deal of space and provides the necessary protection for the gages. The length and thickness gages were placed in double-tier cast-iron drawers which swing from under the workbench. These drawers were hung on vertical rods, pivoted in the cast-iron legs of the bench, and were designed to swing readily at the touch of a finger. The drawers were lined with wood, and the gages separated from each other by wooden strips, thus obviating the possibility of their being damaged and their accuracy destroyed by being knocked about. Plug and ring gages were placed on a shelf, six inches deep, as shown in Fig. 1 at the end of the rack. This shallow shelf allows every gage to be placed in the front row so that each one can quickly be located, taken out, and replaced without danger of knocking over or injuring the other gages. The small and consequently less stable sizes were fitted in holes of corresponding size, drilled in a board which was placed on the top of the metal shelf.

Fig. 2. Steel Compartments and Elevated Shelves. Each Division is provided with Fixed Check Hooks

In Fig. 2 the various taps, reamers, drills, etc., will be seen, arranged conveniently in compartments and on shelves. The standard check system was put into use and, as will be noted from the illustration, each tool, besides being properly labeled, was also provided with a check hook.

* * *

When small quantities of molybdenum are added to steel, for instance 0.25 per cent, the elongation and elastic limit of the steel is greatly increased. When combined with nickel, the resistance to shock is increased, the elongation being the same.

LETTERS ON PRACTICAL SUBJECTS

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EXPANDING BRASS TUBES ON A POWER PRESS

The brass tube illustrated in Fig. 1 at *A*, *B*, and *C* is shown in three stages of manufacture. The tube is made of a rectangular blank of No. 16 gage sheet brass which is rolled to cylindrical shape, and the seam is brazed, making a butt joint. In considering the stress that is exerted in the expanding and stretching of the metal from which these tubes are made, it is obvious that the joints must be well brazed in order to withstand the strain. While the results will not always be perfect, the defects in the pieces that open are due to poor brazing, the metal frequently being burnt. Such tubes are reclaimed by being rebrazed and again put through the dies and brought to the desired form. In rolling and brazing the tubes, it was found impracticable to attempt to hold the work to the 6.020-inch dimension, it being almost impossible to get all tubes alike in diameter. This is due to the uncontrollable conditions arising from applying the pressure on the blank, and also from the effect of the heat while brazing the seam.

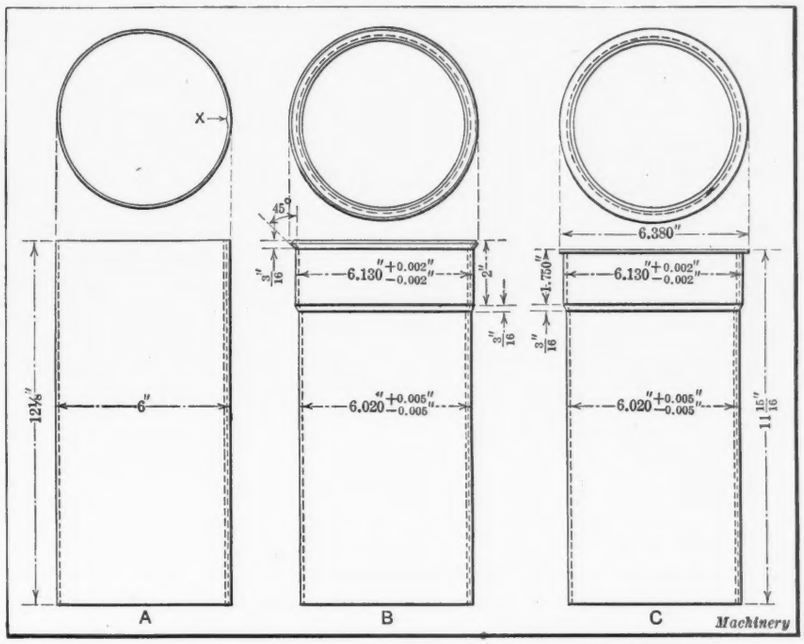


Fig. 1. Tube to be expanded, before and after Press Operations

Referring to Fig. 1, the tube is shown at *A* before being placed in the power press. The heavy brazed seam is visible at *X* and it will be seen that proper provisions must be made for this seam in the dies. Consequently, clearance must be provided in the punch for the seam, and the tube must therefore be placed in the dies so that the brazed seam will correspond with the clearance in the punch. The dies will not be injured however, if the tube is placed in the dies in any other position, but the section of the tube which is to be made 6.020 inches in diameter will be larger than specified and therefore cannot be used.

The tube shown at *B*, Fig. 1, has been expanded and the flange turned to a 45-degree angle in the die shown in Fig. 2. The dies are of the positive expansion arbor type and are operated in a 14-inch stroke draw press, running at 40 revolutions per minute. The punch *A*, Fig. 2, and the tapered mandrel are one piece, which is made of tool steel, hardened and ground, and carries a washer *B* and a retaining nut *C* at the lower end. The washer *B* determines the amount of movement that is necessary to expand sections *D* when the punch descends, and to contract them when the press returns to high center. These sections *D*, of which there are four, are made of tool steel, hardened and ground, and form the outer wall of the punch. The tapered arbor of the punch is square in section. The amount of taper is 2¼ inches in 13 inches, and the arbor continually engages the walls of sections *D* by reason of the spring rings *E* which fit into channels, as shown, and hold the four sections by compression against the punch arbor *A*. A square punch arbor is more practical than a round one, for the square type is at all times fully engaged with the punch sections *D*, whereas a round arbor, as will readily be understood, cannot meet the change of radii caused by expansion, and will split when it is subjected to a heavy strain.

Reference to the views in Fig. 4 will emphasize the advantages of the square arbor. *A* shows the punch sections expanded by a round arbor, and the opening at *X* illustrates the poor contact of this type of arbor. *B* shows the same punch expanded by a square arbor; the advantages of this type of punch are obvious.

When the punch *A*, Fig. 2, is not in operation, the tapered sections *D* rest on the retaining washer *B* by reason of the pressure exerted by the helical springs *F* on the pressure plate *G*. This plate is made of tool steel, hardened and ground, and is located in the proper position by the four studs *H*. The die *I*, Figs. 2 and 3, is made of machine steel in two sections, and has an inserted ring *J*, which is hardened and ground and secured to the die by the fillister-head

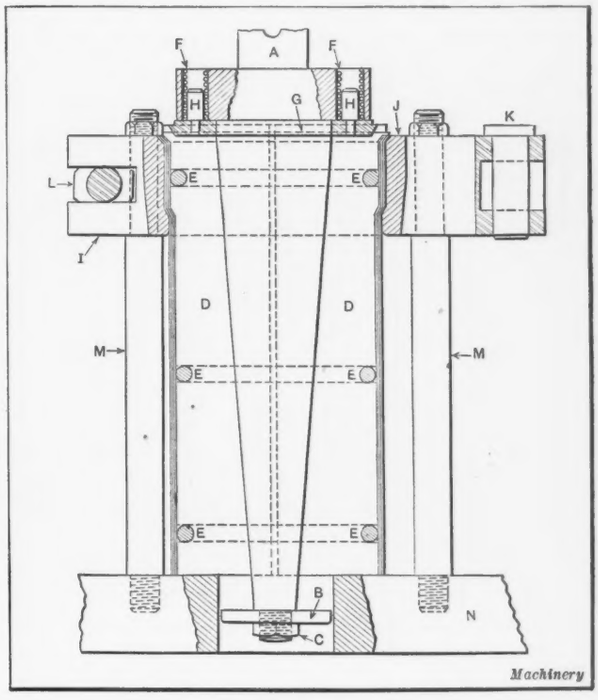


Fig. 2. Sectional View of Punch and Die

screws *O*. The front section of the die is operated by swinging on the pivot stud *K*, and when closed is clamped by the cam lever *L*. This section is merely supported on the bolster plate *N* by the three studs M_1 which screw into the under side, with the lower ends resting on the plate. The rear section of the die is stationary and held securely to the bolster plate by the three studs or tie-rods *M*, the construction being shown in Fig. 2. Where ordinary expansion takes place, such as at the lower part of the tube, it is not necessary to confine the work, but on the upper end this must be done, because the tube is not only expanded but also formed. The bolster plate *N* is made of cast iron and is bolted to the press bed, through holes *P*.

The flanging die is shown at *A*, Fig. 5. This die is very simple in construction and works automatically when the press is in operation, being connected to the crankshaft of

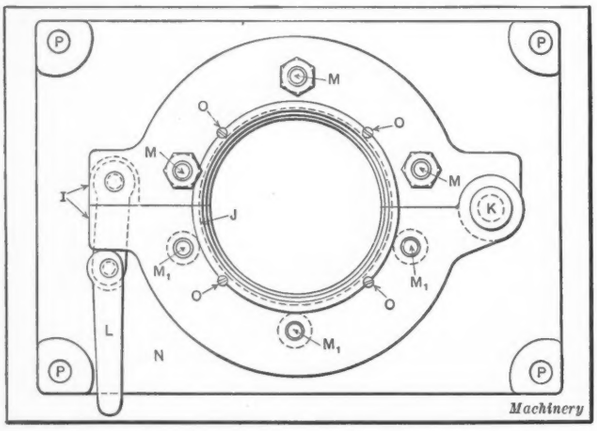


Fig. 3. Plan View of the Die, showing Hinged Construction

the press by the levers *B*. This punch and die is operated in a 4-inch stroke horn press, and is so adjusted that the die is brought to an upright position and at rest before the punch on its downward stroke comes within one inch of the die. Also when the die starts to return to the 45-degree position, shown dotted in Fig. 5, the punch has cleared the die by one inch. This clearance is necessary since the tube rests on a spring-actuated knock-out pad *C*, which partly ejects it after the flange has been formed and holds it clear from the top of the die so that the operator is enabled to remove the tube instantly when the work is finished. The construction of this cushion-like arrangement under the tube is, of course, apparent. The punch *D* is made of cast-iron, and carries a hardened tool-steel plate *E* which is held in place by the machine-steel pilot *F* by means of the fillister-head screws *G*. The die *A* is made of cast iron having a 0.010-inch clearance for the body of the tube, and is provided with a steel ring *H*, which is hardened and ground and then pressed into position as shown. The die *A* is seated on the cast-iron bracket *I*, the seat of the bracket being made to

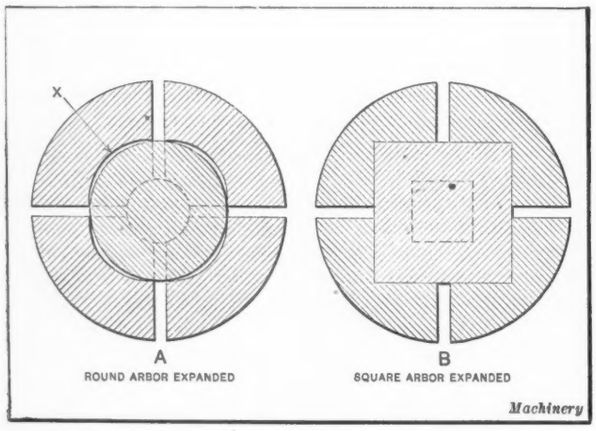


Fig. 4. Diagrams of Round Arbor and of Square Arbor

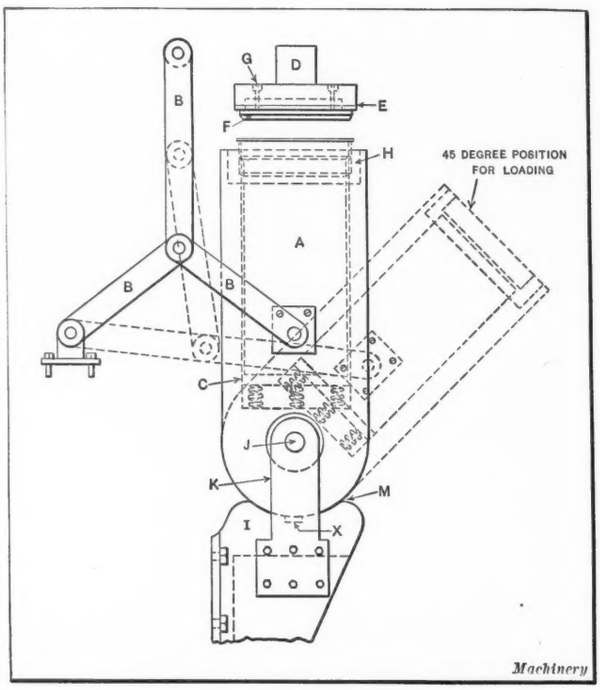


Fig. 5. Flanging Punch and Die

the same radius as the end of the die. The die is supported by the steel shaft *J* which is mounted in the bearing brackets *K*. The bearing surfaces at *M* must be well oiled, and for this reason an oil pad is provided in the recess at *X*.

Highland Park, Mich. ERNEST A. WALTERS

FIXTURE FOR MILLING OIL-GROOVE IN BUSHING

Figs. 1 and 2 show a special milling fixture designed to hold the brass bushing *A*, while milling the oil-groove *B*. The fixture with the bushing in place may be seen in Fig. 1.

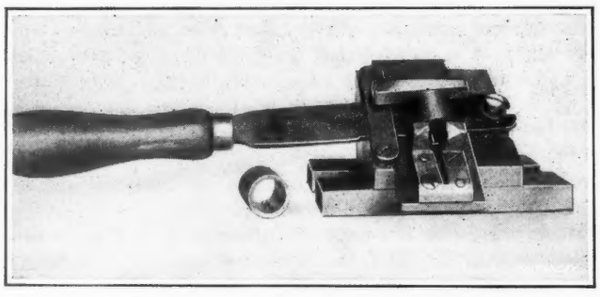


Fig. 1. Fixture for holding Bushings when milling Oil-groove

The detailed construction of the fixture, however, will be more clearly understood by referring to Fig. 2. The fixture consists of a base *C* which carries a slide *D*, set at an angle of about 30 degrees with the base. The V-block *E* supports the work, which is held between the angle-plates *F* and *G*. Plate *F* forms a stop for the work, while plate *G* is milled to make provision for the insertion of the wedge *H*. The hand-lever *J* is more clearly shown in Fig. 1. To operate this fixture, which may be used on any milling machine, the cutter *K* is placed in the horizontal spindle of the machine, and the fixture set up facing it. The method of holding the bushing during the machining of the groove is apparent from the illustrations, which show it seated in the V-block and held firmly between the angle-plates by the wedge. After the wedge has been driven into place, the cutter is fed into the work to the required depth, and the slide *D* is operated by means of the hand-lever *J* advancing the bushing until the proper length of the groove has been milled.

This fixture could no doubt be greatly improved upon by

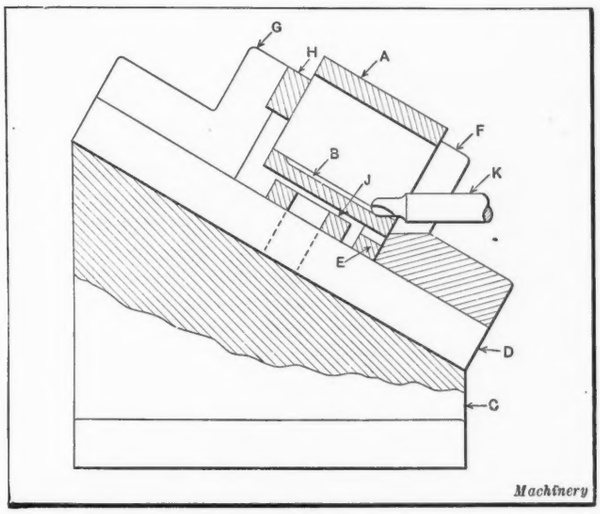


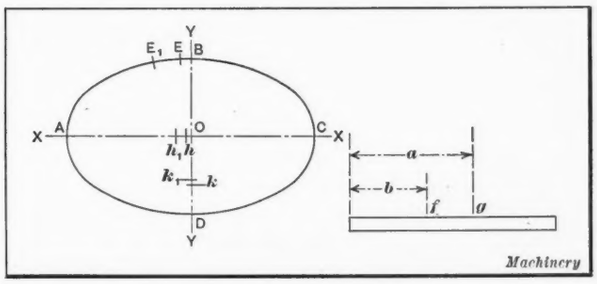
Fig. 2. Detail View of Milling Fixture shown in Fig. 1

the addition of better means of clamping the work, and could also be made to handle a wider range of work by the addition of suitable stops for controlling the length of the cut. However, for the particular job for which the fixture was designed, this was not thought necessary, as the quantity of pieces to be machined did not warrant it.

New York City DONALD A. BAKER

METHOD OF DRAWING ELLIPSE

The following method can be used in constructing an ellipse covering any given length of axis, and with a little care very accurate results can be obtained. With the two axes *AOC* and *BOD* given, the ellipse is constructed in the following manner: On a straightedge or small piece of paper, as shown at the right in the accompanying illustration, mark off *b*, equal to *BO* on axis *YY*, and *a* equal to *AO* on axis *XX*. Then choose a point such as *h* on axis *XX* and



Method of constructing an Ellipse

place the straightedge so that point *f* coincides with point *h*. With point *h* as a center and *fg* as a radius, revolve the straightedge until *g* intersects the axis *YY* at some point; as at *k;* with the straightedge held stationary in this position, mark off point *E* at a distance from *k* equal to *a*. Then choose another point, as h_1, and repeat the process until enough points have been located to obtain the required curve.

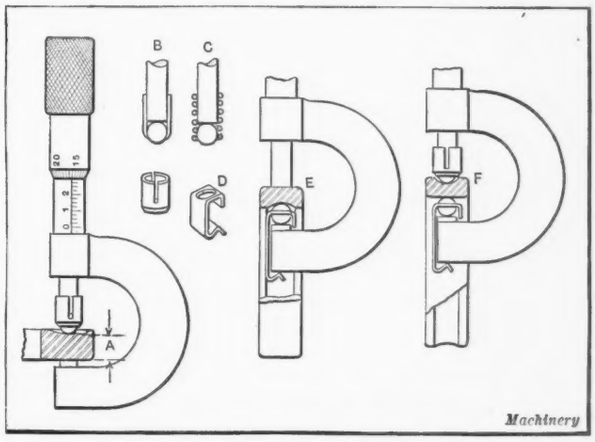
Newark, N. J. C. S. SELTZER

BALL-POINT ATTACHMENTS FOR MICROMETERS

Ball-point micrometers are ordinarily used to measure the depth of the groove in ball bearing races, but when this type of micrometer is not available an ordinary micrometer can be used for this purpose by attaching balls to the contact points. Some of the methods used in attaching the balls are shown in the accompanying illustration, and these may also be found of use in measuring other work of a similar nature.

In making thrust bearing races, it is necessary to keep the dimension *A* uniform within close limits at all points. For measuring this thickness a ¼-inch ball is fitted to the spindle of the micrometer in the manner shown at *B* or *C*. For micrometers having ¼-inch spindles, the method shown at *B* gives the best results. The thimble which holds the ball is split, as shown, and the outer end is closed a little so that it fits tightly over the spindle. Some micrometers are made with a 7/32-inch spindle, in which case the use of a spring as shown at *C* will be advisable, as by this method it is possible to use a ¼-inch ball. A ¼-inch ball will be found more convenient from a practical standpoint since the diameter of the ball has to be subtracted from the reading of the micrometer to obtain the actual thickness.

For measuring the radial thickness of the outer race of an annular bearing, the ball is fitted on the anvil instead of on the spindle. To accomplish this a 7/32-inch hole is drilled in a strip of thin sheet steel, which is then bent to the shape shown at *D* and used in the manner indicated at *E*, the 7/32-inch hole fitting over the ¼-inch ball. In this way, it is



Ball-point Attachments for Micrometers

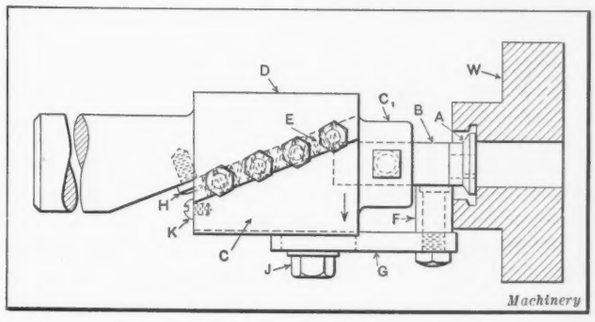
possible to attach a ball to both spindle and anvil so that the radial thickness of the inner race of an annular bearing can be measured as shown at *F*. In order to obtain accurate measurements with ball-point micrometers, a very light "feel" should be used, owing to the small contact area of the ball points.

Rochester, N. Y. GEORGE C. HANEMAN

RECESSING TOOL

The machining of an internal recess to close limits on an automatic screw machine often causes trouble, owing to the difficulty encountered in securing a recessing tool that will do the work desired satisfactorily. It is surprising to know the amount of rejected work that has resulted from the incorrect machining of internal recesses, particularly where such work has been done by inexperienced workmen. On ordinary work requiring close limits, such as the bottom of an internal thread, about 90 per cent of the rejected work is undoubtedly due to improper machining of the recess.

The tool shown in the accompanying illustration has been found to be both practical and reliable. The tool is shown



Recessing Tool for Automatic Screw Machine

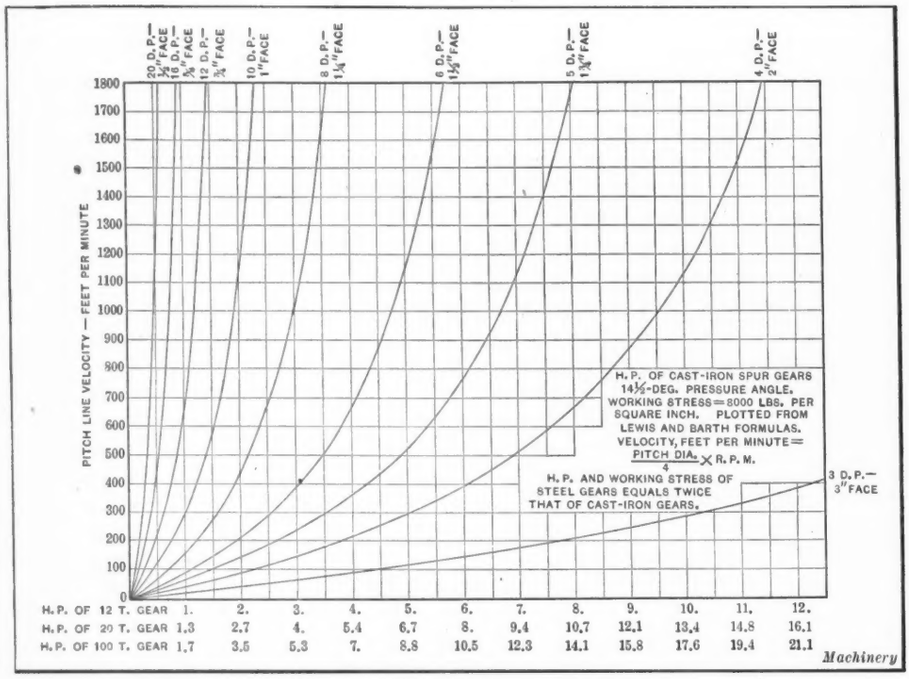

20 D. P.—¾" FACE
18 D. P.—⅞" FACE
12 D. P.—¾" FACE
10 D. P.—1" FACE
8 D. P.—1¼" FACE
6 D. P.—1½" FACE
5 D. P.—1¾" FACE
4 D. P.—2" FACE
PITCH LINE VELOCITY — FEET PER MINUTE
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
H. P. OF CAST-IRON SPUR GEARS 14½-DEG. PRESSURE ANGLE. WORKING STRESS=8000 LBS. PER SQUARE INCH. PLOTTED FROM LEWIS AND BARTH FORMULAS. VELOCITY, FEET PER MINUTE = PITCH DIA. / 4 × R. P. M.
H. P. AND WORKING STRESS OF STEEL GEARS EQUALS TWICE THAT OF CAST-IRON GEARS.
3 D. P.—3" FACE
H. P. OF 12 T. GEAR 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.
H. P. OF 20 T. GEAR 1.3 2.7 4. 5.4 6.7 8. 9.4 10.7 12.1 13.4 14.8 16.1
H. P. OF 100 T. GEAR 1.7 3.5 5.3 7. 8.8 10.5 12.3 14.1 15.8 17.6 19.4 21.1
Machinery

Chart for determining Horsepower of Gears

in its assembled form together with the recessed work *W*. The recessing tool proper *A* is threaded and assembled on the pin *B*, which is held in the nose C_1 of the slide *C*, by means of a set-screw. The slide operates on the holder *D* and is provided with a blind hole which carries the release spring *E*. The slide *C* is fitted to the holder by means of a dovetailed way and rides on a gib which is secured in the ordinary manner. The fillister-head screw *H* forms a stop for the spring, and the round-head machine screw *K* forms a stop for the slide, by means of the overlapping head, as shown in the illustration. The roller *F* is held on a pin which is carried on the end of the adjuster *G*. The adjuster is held in place by cap-screw *J* which passes through an elongated slot in *G*. When the tool is fed forward, the roller *F* comes in contact with the work and thus stops the forward movement of the slide *C*. The tool will then assume the position shown in the illustration. As the tool-holder *D* continues to advance, against the action of spring *E*, the slide *C* is forced outward, as indicated by the arrow, until the recess is cut to the required depth. When the holder *D* is withdrawn, the action of spring *E* tends to hold roller *F* against the work, until the holder *D* has come into contact with the stop-screw *K*. The adjuster is properly set so that the roller *F*, when in the advanced position, bears against the work and determines the distance from the outside of the piece to the bottom of the recess.

One particular advantage of this type of tool is that it has no adjustable stop to become disarranged, as adjustment for the depth or diameter of the cut is accomplished when setting the tool-holder into the tool-block.

Washington, D. C. M. H. POTTER

HORSEPOWER CHART FOR SPUR AND BEVEL GEARS

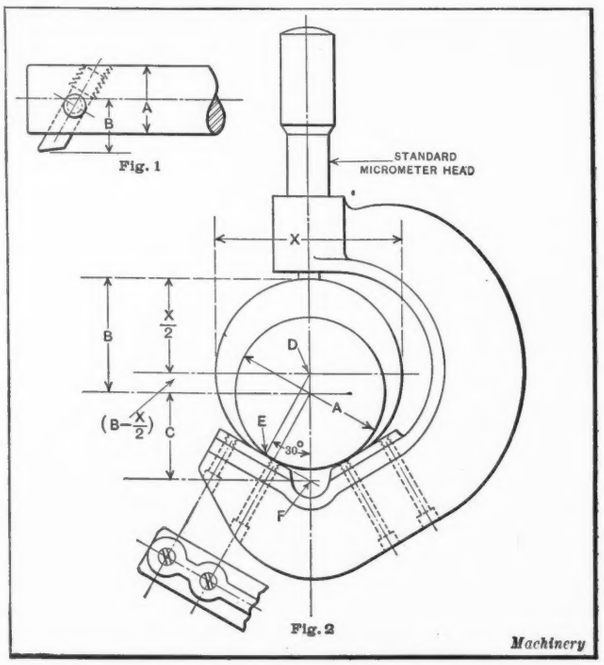
The accompanying chart, plotted by the writer from the Lewis and Barth formulas, and never before published in any journal, will be found a ready means for obtaining the horsepower of cast-iron and steel spur gears. The gears having the most common numbers of teeth are given, that is, 12, 20, and 100, the horsepower increasing with the width of face and size of tooth, as indicated by the diametral pitch. If it is desired to determine the horsepower of gears having a different width of face than those given in the chart, the horsepower determined from the velocity and pitch should be multiplied by the ratio of the nearest width of face given on the chart, to the width of face of the desired gear, since horsepower is in direct ratio to the width of face. If the horsepower of a bevel gear is to be determined, the average between the diametral pitch at both ends of the tooth should be used. It will be noticed that the chart does not provide for a higher velocity than 1800 surface feet per minute, since gears running at a higher speed than this are very noisy and are not often employed. The factor of safety for spoked gears running at a speed of 1800 surface feet per minute is approximately 2¾.

It is well to remember that the horsepower of gear drives is an uncertain quantity, much depending upon the quality of material and workmanship. The weakest gear in any set should, of course, be used when making horsepower calculations.

Dorchester, Mass. M. T. SCHUMB

MICROMETER FOR SETTING BORING-BAR FLY CUTTERS

A special micrometer designed for setting fly cutters on boring-bars, such as shown in Fig. 1, is illustrated in Fig. 2. The micrometer is set before being used on the boring-bar by means of hardened and ground steel disks, one disk being required for each size of hole to be bored. As shown in the illustration, the bar is set in the micrometer while the cutter is being gaged, and is held by means of the three-point contact formed by the two 60-degree seats and the spindle of the micrometer. The problem, then, is to determine the diameter of the disk to use for a given sized hole, the diameter of the boring-bar being known. This would involve a long calculation if a suitable formula were not available.



Figs. 1 and 2. Boring-bar and Micrometer for setting Cutters by Means of Ground Steel Disks

Referring to Fig. 2, let

X = diameter of disk;
A = diameter of boring-bar;
B = radius of hole.

In the triangle DEF,

$$DE = \cos 30 \text{ degrees } (B - \frac{X}{2} + C) = \frac{X}{2}$$

$$X = \cos 30 \text{ degrees } (2B - X + 2C)$$
$$= \cos 30 \text{ degrees } (2B + 2C) - \cos 30 \text{ degrees} \times X$$
$$X + \cos 30 \text{ degrees} \times X = \cos 30 \text{ degrees } (2B + 2C)$$
$$X\,(1 + \cos 30 \text{ degrees}) = 2 \cos 30 \text{ degrees } (B + C)$$
$$X = \frac{2 \cos 30 \text{ degrees } (B + C)}{1 + \cos 30 \text{ degrees}} \qquad (1)$$

But, $$C = \frac{A}{2 \cos 30 \text{ degrees}}$$

Substituting in Equation (1),

$$X = \frac{2 \cos 30 \text{ deg.} \left(B + \dfrac{A}{2 \cos 30 \text{ deg.}} \right)}{1 + \cos 30 \text{ deg.}}$$

$$X = \frac{2B\ (\cos 30 \text{ deg.}) + \dfrac{A\ (2 \cos 30 \text{ deg.})}{(2 \cos 30 \text{ deg.})}}{1 + \cos 30 \text{ deg.}} =$$

$$\frac{2B\ (\cos 30 \text{ deg.}) + A}{1 + \cos 30 \text{ deg.}}$$

Therefore,

$$X = \frac{1.73206\,B + A}{1.86603}$$

G. D. H.

CHEAP BELT CLEANER

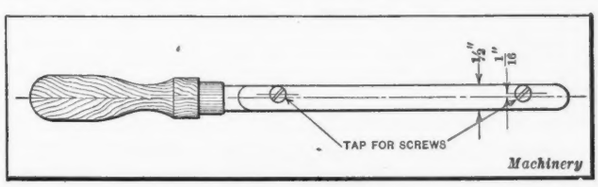
In the January number of MACHINERY, page 461, a brief article appears entitled "A Cheap Belt Cleaner." In the interest of the welfare of belts, it should be mentioned that probably all of these kitchen cleaning powders contain soap powder or free alkali to a greater or less extent, and while they will undoubtedly absorb the oil, they will leave an alkaline deposit on the belt, which is not beneficial, and which, if present in sufficient quantities, will damage the belt.

An inert or neutral powder such as ordinary chalk should be used for the purpose mentioned; it will be found equally successful in absorbing the oil, and will not do any harm to the belt.

Buffalo, N. Y. WILLIAM D. YOUNG
Secretary, Cling-Surface Co.

HACKSAW BLADE HOLDER

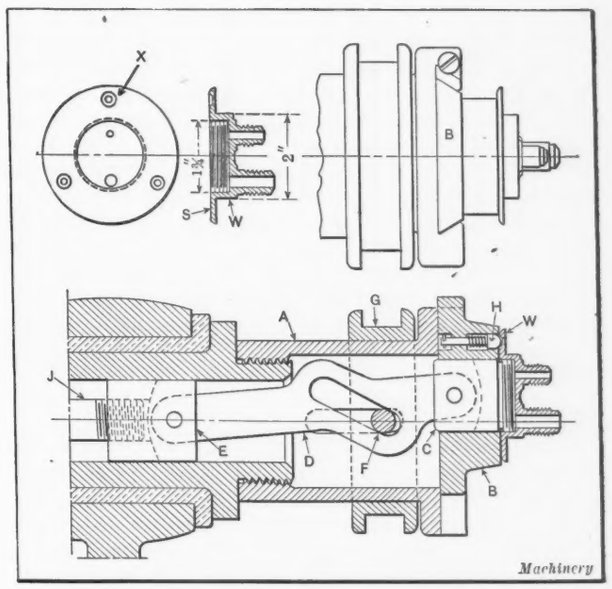
The inexpensive hacksaw blade holder shown in the illustration is of especial value for holding broken blades. Simplicity of construction and rigidity in holding the blade are



Hacksaw Blade Holder

its features. Two pieces of 1/8- by 1/2-inch flat bar stock, tapped for screws as shown and provided with a handle, are all that is necessary. For making wider slots, two or more saws may be used at a time, provided the screws are of sufficient length.

West Haven, Conn. D. D. SYMMES



Air Chuck with Sliding Arbor Device for handling Work which requires More than One Working Center

ADJUSTABLE-CENTER AIR CHUCK

An air chuck which is capable of handling work requiring several machining operations to be performed from different centers without releasing the work is shown in the accompanying illustration. While the chuck was designed for machining such parts as shown in detail at W, in the upper left-hand corner of the illustration, it may be used on any similar work and will be found to be a time-saving device, which is especially desirable on quantity production.

The chuck body A is threaded to fit the spindle nose of the turret lathe, and the outer end is suitably dovetailed and gibbed to receive the slide B, as shown in the plan view. This slide carries the screw arbor C, which is connected through the link D and guide block E with the draw-bar J of the air cylinder. Link D is provided with a cam slot as shown. The bar F passes through longitudinal slots in each side of the body A and extends so that each end is fastened into the shifter ring G, which is free to slide on the outside of the body. The bar F supports link D by means of the slot through which it passes, and it will be clear that any sliding movement of ring G will cause bar F to move in the cam slot in link D, which, in turn, will move the slide B, the arbor C, and consequently the work, to any desired position. The shifter ring is controlled by a forked operating lever carrying suitable shoes which operate between the flanges of ring G. It will be seen that this construction allows the mechanism to be operated while the machine spindle is in motion.

After the piece W has been faced on the surface S, the threads have been tapped in the 1¾-inch hole, and the screw holes X have been countersunk, it is screwed onto the threaded arbor C. The two connection bosses are lined up with the slide by means of a small spring plunger H which snaps into the countersunk screw hole X. This brings the centers of the two bosses and the center of hole X into a parallel line with the dovetailed way of the slide B. The machine is then started, and by means of the operating lever, the work can be almost instantly located in such a position as to bring the center of the small boss into alignment with the center of the machine spindle. The work is held in place while the machining operations are performed on the boss by applying air pressure to the air cylinder. The action of the compressed air on the piston causes rod J to draw back link D which is connected with screw arbor C, thus clamping the work firmly against the slide B. In order to locate the work so that the turned portion indicated by the 2-inch dimension may be machined, it is only necessary to release the air, and shift the operating lever as before while the spindle

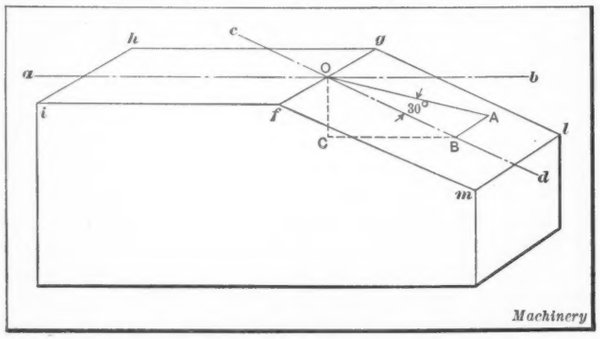
remains in motion. After the work has been turned to the required 2-inch diameter, it is located in the proper position for turning the large boss.

It will be understood that this particular piece of work does not require that the centers be very accurately located, as the revolving work is trued by the eye of the operator only. However, if close accuracy is desired, it might be maintained by using a taper lock-pin in the slide *B*, actuated by the movement of the air cylinder, which would engage holes accurately located for each working position in the main chuck body. This device has proved of great value, and there may be many other parts involving eccentric machining upon which an adaptation of the idea might be used to advantage.

Bridgeport, Conn. K. H. CONLEY

DOUBLE AND COMPOUND ANGLES

In the November number of MACHINERY was published an article entitled "Double and Compound Angles." In the following article is described a practical method of locating a point on a piece of work, the position of which is determined



Example of Work requiring the Solution of Compound Angles in determining Location of a Certain Point

by the solution of compound angles. The previous article described the method of laying out compound angles on an elevation drawing, and is not applicable to lay-out work in the shop, as its use is limited to problems encountered in construction drawing. The following method, however, can be employed in the shop, and when used in connection with tables of natural trigonometrical functions, should enable one to quickly and accurately lay out work of a similar nature to that shown. Referring to the illustration, *A* is a given point on a casting, located at a distance *OA* from the intersection of center lines *ab* and *cd*. Angle *AOB* on the surface *fglm* of the casting is equal to 30 degrees, and the angle between this surface and the extended horizontal plane of the top surface *hifg* of the casting is also equal to 30 degrees. It is required to locate by "square" dimensions on the plan and elevation drawings the exact position of the point *A*.

Draw line *AB* perpendicular to center line *cd* on the plane *fglm*, thus forming the right triangle *AOB*. In this triangle *AB* equals *AO* sin 30 degrees, which is the dimension perpendicular to center line *cd* on an inclined plane of 30 degrees. In the same triangle *OB* equals *OA* cos 30 degrees. Now in a vertical plane draw *OC* perpendicular and *CB* parallel to *ab*, forming the right triangle *OCB*. In this triangle *CB* equals *OB* cos 30 degrees, which is the required "square" dimension parallel to center line *ab*. Now *OC* equals *CB* tan 30 degrees; *OC* is the required "square" dimension perpendicular to center line *ab*.

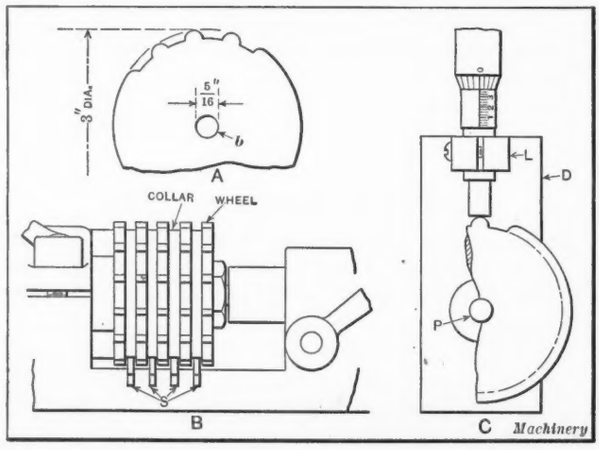
Battle Creek, Mich. H. H. METCALF

SUPPORT FOR A SLENDER ARBOR

The toothed-wheel blank shown at *A* in the accompanying illustration was to be milled to the finished diameter, the particular part of the job being to have the circumference containing the high points of the teeth or lobes concentric with hole *b*. The blanks were punched out on a power press and it was intended to mill only the lobes and to leave the parts between them just as punched. Accordingly, a forming cutter was made for finishing two lobes at one cut. One-sixteenth inch of metal was to be left on the lobes for finishing purposes, and a clearance of an equal amount should have been provided in the parts between the lobes. However, through unauthorized changes made in the press department, the blanks were punched with an added 1/16 inch of stock all over and the diameter of the hole was made 5/16 instead of 9/16 inch. This change in the size of the blank more than doubled the amount of work that the cutter was required to do, and brought the milling cost far beyond the original estimate. It had been intended to clamp half a dozen blanks onto the arbor which was provided with journals in solid bearings, and to revolve the work by means of a direct indexing head. While it was found possible to get fair production from this outfit, the concentricity required for the lobes could not be obtained by taking a single cut over the work, owing to the springing of the slender arbor away from the cutter. The design illustrated at *B* was accordingly adopted, and this effectually eliminated the trouble.

A longer arbor was made having end journals as before, but turning in divided bearings equipped with quick-action clamping devices to facilitate loading. A second arbor was loaded by the operator while the cut was being made in the work carried on the first arbor. The feature of the arrangement was the increased length of the arbor, which held but five blanks and carried a spacing collar between each pair, as shown in the illustration. The collars were hardened and ground to the same diameter, and when in position were supported on the steps *S* of a block attached to the base of the fixture, an arrangement which effectively stopped all springing of the arbor in that direction. By making the steps only ⅛ inch across the top and sloping the metal away from the top to provide rake, no trouble was experienced from chips crowding in. Although the cut was longer, the actual time consumed in milling was considerably less than with the unsupported arbor, but the most important advantage was the accuracy obtained, which was all that could be desired.

The fixture used for testing and inspecting is shown at *C*. It consists of a piece of bar steel *D*, which serves as the base, in which is set the center plug *P*. The micrometer head, which is clamped in the lug *L* at one end of the base,



Toothed-wheel Blank, Milling Fixture, and Concentricity Gage

is set to zero on a reference disk of the correct diameter, and gives a direct reading for any deviation in size or concentricity of the wheel. Such a gaging fixture is remarkably inexpensive to construct, the micrometer head being its only accurately made member, and that may be used for a number of jobs, even though the rest of the fixture is scrapped after the work on this particular job is completed.

Middletown, N. Y. DONALD A. HAMPSON

Industrial Readjustment

Training Disabled Men—British Embargo on Machinery—Foreign Trade—Employment Service for Technical Men

TRAINING DISABLED MEN FOR SELF-SUPPORT

By DOUGLAS C. McMURTRIE, Director, Red Cross Institute for Crippled and Disabled Men, 23rd St., and Fourth Ave., New York City

IN the past, the method of dealing with men disabled in the course of employment has been to pay them a pension, or compensation, and to let the matter end there. As the compensation was often temporary, in many cases these men ultimately became a burden to society. Recently, however—particularly since the war—it has been realized that the obligation to disabled men and the interest of the community demand something more than this, and various movements have been started with a view to training the men to become self-supporting.

Methods of Reducing Cost of Disability

The cost of disability to the machine industry has not been alone in premiums paid for casualty insurance, but also in the cost of training and adapting the skilled worker who has been disabled for some other work, and in fitting an unskilled worker to take his place. There are three means of reducing the cost of disability: first, accident prevention; second, medical attention to minimize disability; third, salvage of the remaining abilities of the worker through rehabilitation for self-support. The first of these has already received wide attention from employers and has been encouraged in a financial way by casualty insurance companies and state funds. The values of the other two, however, have not as yet been appreciated. The energetic application would effect a tremendous saving to industry.

Adequate Medical Attention

Many injuries from which men would recover completely in a short time under adequate medical attention are treated for an insufficient time, or by incompetent physicians, and, the case extends over a long period or develops into permanent disability. Some states require the insurance carrier to provide but two weeks of free medical attention to the injured man. For the insurance company to take advantage of this limitation is a short-sighted policy because for every dollar saved in physicians' or hospital fees, the insurance carrier pays out ten dollars in compensation; and what the insurance company pays is actually paid by the insuring employers in their regular premiums. Unlimited adequate medical attention should be an axiom of casualty practice, and should be demanded by both employer and workman. The aim should be to have the employe return to his job fully recovered, in the shortest possible time. It is well to develop a science of dealing with cripples, but the ideal is to have fewer cripples.

Rehabilitation for Self-support

The third method of lessening the cost of disability is rehabilitation or re-education for self-support. The science of rehabilitation is new, and practically all the experience in it has been gained in the effort to make just provision for the disabled soldier or sailor. Every country among the recent belligerents today is operating a comprehensive system of re-education for disabled soldiers, and is placing more dependence upon that system than upon the pension system.

Paying a man a small monthly or weekly stipend on which to live in idleness is not a constructive method. The only real compensation for disablement is restoration of capacity for self-support. Few jobs require all the physical faculties, and in the present-day variety of industrial processes it is possible to find a job in which a man with a given type of disability can function with 100 per cent efficiency. Some jobs are performed standing, some seated, others require walking about, while some jobs at a bench working on small articles need but little strength, and still others involve great physical exertion. There are jobs that do not require the sense of hearing; in others, sight is not essential. Finding the future work of the disabled man, therefore, requires expert and painstaking choice, but a successful selection is possible even for the seriously handicapped. The aim is to place the man in a different job in his own trade or in one closely related. In such a job, his past experience serves as a foundation. If this is impossible he can be retrained for a different line.

Special School for the Crippled and Disabled

The process of retraining the disabled is known as re-education, and can be provided best in a special school for crippled men. The first school of this kind in the United States is the Red Cross Institute for Crippled and Disabled Men, established in New York City. At this school, which is open to disabled civilians and soldiers alike, six trades are already being taught: Artificial limb making, motion picture operating, oxy-acetylene welding, printing, jewelry work, and mechanical drafting. More will be added as the demand develops. Graduates are already giving satisfaction, and the enterprise has passed the experimental stage. In the results attained with disabled soldiers abroad, there is overwhelming evidence of the logic and practicability of rehabilitation.

How Re-education Reduces Cost of Disability

The cost of the re-education of disabled soldiers is being met by the United States Government and by the Governments of some of our allies. It is desirable that the advantages of rehabilitation be made available to disabled civilians also, since rehabilitation effects a reduction rather than an increase in the cost of disability to industry or to the community as a whole. A typical case will illustrate how the saving is effected. A worker in Massachusetts was injured by a fall while working inside a submarine, and his hand became permanently crippled. In due course his compensation rate was determined and he was referred to the insurance carrier to be paid $10 a week for a long period, with a maximum total payment of $4000. Since the disability was manifestly permanent, the insurance company wrote the case off their books as a $4000 loss, and transferred that amount to reserve to cover the weekly payments. After the compensation had been paid for nearly a year, a new official of the company had his attention directed to the man in

question and the latter was requested to call at the office of the company. The official proposed to the disabled man that he go to a school of re-education at the company's expense, to be recapacitated for self-support. The man consented and he was sent to the Red Cross Institute in New York. The company paid him, not $10 a week as required by law, but $40 a week, $20 to him in New York and $20 to his wife at home. His traveling expenses were also paid by the company. In eight weeks he was re-educated in oxy-acetylene cutting and welding and returned home. He is now making not only a satisfactory wage but twice as much as he had ever earned before the accident took place.

In the whole transaction, everyone interested was benefited. The man profited in that his general living standard was raised. The company paid less than $500 for his rehabilitation, and this expense, in conjunction with the $500 paid in weekly compensation during the first year of idleness, made a total for the case of $1000. The community was decidedly the gainer in that the man, formerly an unproductive consumer, became a useful producer. Society further gained in the elimination of the disabled man from the category of a prospective dependent.

Need of Revision in Compensation Laws

A more intelligent handling of disability by insurance carriers will, therefore, reduce their expense, and will thus decrease the cost of casualty protection to the employer. There is needed also, however, some revision of compensation laws so that there may be definite encouragement to insurance carriers to offer opportunity of rehabilitation, and to the disabled men to take advantage of it. Practically every compensation case that has come to the Red Cross Institute has come on the day disability compensation expired. For one or more years the man has existed in idleness, drawing compensation and cultivating habits of indolence. Only when support was cut off did he become interested in rehabilitation. Present compensation legislation tends to encourage a man to remain idle because his payments are reduced by any improvement in earning capacity. A revision of the law will make for more constructive results.

In short, the first effort should be to prevent injury, the second to minimize its permanent effects, the third—when disability has ensued—to offset its economic consequences. The execution of this program is not only sound, humanitarian practice—it is good business as well.

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BRITISH EMBARGO ON MACHINERY AND MACHINE TOOLS

The War Trade Board announces, for the information of exporters in the United States, that the following changes have been made in the import regulations of Great Britain. After March 1, 1919, the following classes of machinery on which the British import prohibitions had been removed, will again be on the list of prohibited imports and can be imported after that date only under special license:

Machine tools, and machinery driven by power and suitable for use in cutting, stamping, or working metal, including lathes, grinding machines, milling machines, boring and turning mills, drilling machines, forging machines, planers, punching and shearing machines, shapers, power presses, screw machines, cutting-off machines, chucking machines, gear-cutting machines, boring machines, centering machines, slotting machines.

Machinery driven by power and suitable for use in cutting, working, or operating on wood, including sawing machines of all descriptions, general joiners, mortising, tenoning, and boring machines, lathes and rounding machines, box and cask making machines, and all machines accessory thereto, scraping and sandpapering machines, wheelwright machinery, firewood making and bundling machinery, wood, wool fiber, and pulp machinery, saw sharpening and setting machines, saw stretchers, and brazing apparatus.

Machines for grinding, planing, or molding irons. Weighing machines, scales, and balances of all descriptions.

FOREIGN TRADE NOTES

The French Ministry of Industrial Reconstruction has announced that the control of the Iron and Steel Consortium over imports has ceased, and that hereafter applications for license to import iron and steel should be addressed directly to the Ministry of Reconstruction, Raw Materials Section, Bureau of Importations, Paris. Refusal or approval of applications for license will be given within a period of three days. It is understood that American firms and other branch houses will be given the same consideration in the matter of licenses as is given to French firms.

Exports to Switzerland and the Scandinavian Countries

The War Trade Board has announced that licenses will be issued freely for the exportation to Switzerland of iron and steel, except high-speed steel. It has also been announced that the Allied Governments have informed the Governments of Sweden, Norway, and Denmark that the commodities permitted to be imported into these countries by the several agreements now in effect have been materially increased. With respect to many commodities, including machinery, the limits as to quantity have been entirely removed, and these commodities may now be licensed freely, subject only to the condition that appropriate import certificates have been issued. All exporters whose applications have heretofore been refused, or who have not filed applications because of the lack of import certificates, are advised to communicate with their customers abroad and to request them to apply for import certificates.

The Future Industrial Position of Poland

After the Peace Conference, Poland will emerge again as an independent state, and with this state will doubtless be incorporated those portions of Germany and Austria that were taken from the old Poland more than a century ago. The natural resources of the territory that will be included in the future Poland are such as to insure that the country will play an important industrial part as soon as the effects of the present war have been blotted out. A bureau, known as the Commercial and Industrial Bureau of the Poland National Department, has been organized in New York, having headquarters at 33 W. 42nd St., New York City, the object of which is to help start commercial relations between the United States and Poland and to collect data and information as a basis for the work of future official Polish agencies in this country. Business interests desirous of being placed in touch with the Polish market are requested to apply to this bureau.

The new Poland will have considerable natural resources, especially in coal, oil, salt, potassium, iron, zinc, and lead. The total production of coal within the probable area of the new Poland is estimated at nearly 60,000,000 tons annually, which is greater than the coal production of France previous to the war. The oil industry numbers 1825 wells and employs about 20,000 men, with an output of about 1,200,000 tons. The salt industry has an annual output of about 250,000 tons, and the iron industry an output of about 550,000 tons. The zinc production is estimated at about 750,000 tons, while the production of lead amounts to nearly 70,000 tons. These figures indicate in a general way the industrial position that the new Poland will occupy.

Future Trade between Belligerent Nations

According to historical precedent, there should be not only an early resumption of trade between the belligerents, but also an increase in their trade exchanges. This is merely a statement based upon past experience and not an attempt to forecast definitely conditions of foreign trade as affected by recent hostilities. Whereas French imports from Germany in 1869 were $50,000,000, in 1872, the year after the close of the Franco-Prussian War, they amounted to almost $70,000,000. German imports from France, in turn, rose from $60,000,000 in 1869 to an average of about $83,000,000

in the five years following that war. A similar expansion in trade between the United States and Spain occurred soon after the Spanish-American War, and between Russia and Japan following the Russo-Japanese War.

This war, however, has engendered exceptionally bitter feelings, particularly on the part of the Allies against their common enemy, and yet every country is keenly alive to the importance of foreign trade. It is a matter of common knowledge that Germany, from the very beginning of hostilities, made extensive preparations in neutral and even in enemy countries, for the commercial readjustment that was bound to follow the war. It is an open question whether boycotting the enemy will be successful in preventing the trade that past experience indicates will follow the war.

German Activities to Regain World Trade

It has been pointed out by manufacturers, especially in the hardware lines, that there is a great activity on the part of certain German business interests to regain their pre-war trade, especially in South America and Spain, much of which trade has been replaced by American manufacturers during the war period, or, where it has not been replaced, will be likely to be obtained by American manufacturers within the near future. Agents of German business interests have made inquiries and offered to place orders with American manufacturers for practically their entire output, in certain lines, the object apparently being to prevent the American manufacturer from going direct to the foreign customer with his goods, the German house, instead, taking his product off his hands at the port of New York and selling it through its branch house in South America, Spain, or elsewhere. In a year or two, when the German industries have recovered, the idea, of course, would be to supply this trade with German-made goods, but until that could be done American goods would be substituted. American manufacturers, therefore, should be warned to have no dealings with any firm or individual whose identity is not wholly clear, and are particularly requested to obtain from the War Trade Board, Washington, D. C., the "Enemy Trading List" which gives the names of all firms with whom citizens of the United States are forbidden to deal until after peace has been signed. The "Trading with the Enemy Act" is still in force, and must be carefully observed, and no American manufacturer should accept any order from neutral countries without looking into the "Enemy Trading List" to see whether the firm placing the order may be dealt with.

A Review of the Machine Tool Industry in Germany

An interesting analysis of the machine tool industry in Germany has been made by Walter Waldschmidt, writing in the Berlin Börsen-Courier, as reported by Vice-consul Orsen N. Nielsen, Stockholm, Sweden, to the United States Bureau of Foreign and Domestic Commerce. Waldschmidt expresses some anxiety concerning the ability of Germany to compete successfully in the machine tool field after the war. According to the writer, when, in 1890, the rapid industrial development of Germany had caused a heavy demand for machine tools, it was apparent that the United States manufactured the best machine tools on the market. In fact, American superiority was then so great that he doubted at that time whether Germany could compete with any success, because, to quote verbatim, "machine tools are one of the best, if not the best, of America's products." The technique of the industry was therefore made the subject of intensive study in Germany. The aid of technical schools was enlisted, and workers were sometimes trained in schools erected by factory owners.

About one-fifth of the German manufacturers in this industry are organized as corporations. The largest factories employ under normal conditions from 2000 to 3000 workmen. The Verein Deutscher Werkzeugmaschinenfabriken (Society of German Machine Tool Manufacturers) has 280 members, employing a total of 80,000 to 90,000 men. The financial returns have not been large. From 1910 to 1913, inclusive, nineteen companies earned between 6.2 per cent and 7.7 per cent on their invested capital.

In 1913, Germany's production of machine tools was valued at 300,000,000 marks ($71,400,000). Exports of machines and tools totaled 100,000,000 marks ($23,800,000). In the same year Germany's imports were valued at 10,000,000 marks ($2,380,000), of which machines to a value of 6,000,000 marks ($1,428,000) came from the United States. In marketing their product, German manufacturers found American competition chiefly in England and France. The strongest English competition was encountered in France, Russia, and Italy. Russia was Germany's best customer in 1913.

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PLACING TECHNICAL MEN RETURNING FROM ARMY SERVICE

The Professional and Special Section of the United States Employment Service, a branch of the Department of Labor, having headquarters at 220 Fifth Ave., New York City, has been organized for the purpose of placing employers in need of engineers or technical men in touch with men of special training returning from Army service. The organization announces that it has already thousands of well-educated experienced men on its lists, and is daily placing many of these men in touch with employers. As engineers, executives, and other men of college training and practical experience and training in business and in practical fields are being released by the Army and Navy, they are listed by the Professional and Special Section, and employers are requested to apply to the headquarters of the section when in need of men of this type. The New York office is in charge of the Eastern and Southern Atlantic states, while the Chicago office, with headquarters at 63 East Adams St., is in charge of the Middle West and Western states.

The United Engineering Societies, composed of the four great engineering associations—the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining Engineers—are also cooperating with the Professional and Special Section in placing men in the engineering professions. Employers needing men for any kind of executive, engineering, technical, or accounting work are requested to make their needs known either to the New York or to the Chicago office. The section merely places the employer and the applicant in touch with each other and then leaves them to work out the details for themselves. Often a number of applicants with equally good qualifications are referred to the same employer, in order that he may decide for himself on the basis of his special requirements. It is important that the employer give complete and specific details of the position to be filled, together with the maximum and minimum salary he is willing to pay. These details are regarded as confidential and are withheld from the applicant.

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BUYING NOW WOULD IMPROVE BUSINESS GENERALLY

Those who are contemplating buying will greatly aid the present business conditions of the country, and incidentally their own business, by buying now rather than later. This applies not only to industrial concerns, but also to individuals. If everyone were to stop buying for their personal needs, there would be no commerce and no industry; and to the extent that the public refrains from buying, industry slackens. Therefore, if the public generally, as individuals and as industrial concerns, resumes buying for actual present needs, industry will move again at its normal pace, and the sooner that condition is reached, the better it will be for everybody. Men will be saved from unemployment, and the unrest that generally follows unemployment will be avoided.

The Future of the Machine Tool Trade

BY CHARLES E. HILDRETH

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General Manager, National Machine Tool Builders' Association

In view of the many varying opinions that have been expressed with regard to the probable business conditions during the period immediately following the war, the analysis of the business prospects and the comparison with past experience that have been made by Mr. Hildreth will prove of unusual interest and value. Mr. Hildreth points out that the prospective demands of several important industries are likely to be so great that the country may look forward to a good business for several years to come.

IN juding future conditions, it is sometimes profitable to consider past conditions under somewhat similar circumstances. It is not possible to compare the machine tool trade entirely with its condition in the past, because of the lack of reliable statistics, but we can base a prediction as to future general industrial conditions upon a comparison with those that existed in the past, and these conditions are accurately reflected by the pig iron trade, which produces the fundamental and basic material in all the mechanical industries. The writer prepared a chart for the convention of the National Machine Tool Builders' Association, held at Atlantic City, in 1911, which showed the condition of the pig iron trade, and, consequently, the general industrial condition of the country, since 1825, passing through several successive periods of business prosperity and of depression.

Review of Past Industrial Conditions

Going back as far as 1827, and following the curve all the way down to 1911, there has been a remarkable regularity in trade prosperity and trade depression, in spite of wars, panics, and other upheavals. Successive periods of from eight to ten years each, have been repeated three times, each period showing first a six-year decline and a two-year rise; then a five-year decline and a four-year rise; and finally a seven-year decline and a three-year rise. Following this curve from 1911 to the present time, it shows the end of the last seven-year decline, which was due to end in 1915 and to be followed by a three-year rise up to 1918. Of course, it so happened that the great war coincided with this natural wave, and it is evident that the extraordinary volume of trade of the last three years included the natural increase that was due for the period.

It is curious to note that, although the war started in the fall of 1914, and the war business immediately began to fill the foundries and machine shops to their fullest capacity, the demand for pig iron did not become great enough to cause a rise in its price until July, 1915. The reason for this may be attributed to the fact that, although the machine shops began immediately to meet an enormous demand, practically all the non-essential industries declined for the time being. For example, the typewriter, the sewing machine, the cash register, the calculating machine, and several other industries had a year's business cancelled over night from their customers over seas, and it was not until these industries had readjusted themselves to the new conditions in about the middle of 1915 that the great general demand of the country made itself felt in advancing the price of pig iron, and, thereby establishing prosperous industrial conditions generally.

With the beginning of 1919, we enter upon an eight-year period having an indicated six-year gradual decline and a two-year rise. This period coincides with the period immediately after the Civil War, which was preceded by a three-year rise from 1861 to 1864, followed by a six-year decline from 1864 to 1870. After that there was a spectacular two-year rise of great railroad building until 1872. The years from 1864 to 1870 were by no means marked by poor business conditions, because, as a whole, the country was unusually prosperous for several years after the war, and prices did not decline and reach rock bottom until 1870, when the real constructive business began.

The Prospect for the Immediate Future

It was evident that immediately following the cessation of hostilities there had to be a reaction, the effects of which we still feel. How long it is going to last we cannot possibly say, but there will be a period of uncertainty during which the world will await the settlement of the peace terms and become assured of the permanency of peace. After that there will be adjustments to the new conditions, and when this has taken place, there will be a gradual decline in business for six years, which may be said to be a reasonable length of time for arriving at stable conditions on which to build for the future. During this period of six years, however, we are not to face any serious upsetting of business. Instead, the same as during the years following the Civil War, there is bound to be a remarkable amount of necessary work to be done, and the business will be such that if we had not had the abnormal war business to use as a standard by which to measure, we would have considered it a boom as compared with the normal business that we had before the war.

Reasons for Demand for Machine Tools at the Present Time

First, consider the railroads. For over ten years, owing to insufficient rates and to control by the Federal Trade Commission, the railroads have ceased to have their regular buying periods, at which times general business was always stimulated. Since the war began and the Government took over the railroads, it would have been possible for them to furnish the equipment required, providing this opportunity had not been made impossible on any large scale because of the paramount war demands and war prices. Now that the war demands are over, the buying of the railroads is likely to become enormous.

The development of the railroads will not be affected by public uncertainty; nor will the development of the great shipbuilding industry which is large and wholly new. The extent of the shipbuilding industry can hardly be imagined except by those who are thoroughly familiar with it. Speaking of millions of tons means little to the man who is not in the shipbuilding trade, yet we all realize how enormous this industry is, and how great it is bound to remain, when we think of the millions of tons that were lost during the war and that will have to be replaced; and other millions of tons must be added, in order to take care of the natural increase of the world's commerce.

The Future Aircraft Industry

It may seem, perhaps, that the aircraft industry is not going to become of great importance for many years in the future. Yet those who still remember the introduction of the telephone may recollect that it was considered a nice plaything, but it was not believed that it would be commercially useful. The writer's father, in fact, refused Bell telephone stock at ten cents a share for that very reason.

Now the telephone business (and all the industries tied up with it) has become one of the large industries of the nation. The aircraft industry will some day be in the same class. If it is possible to fight in the air, how much easier it is to conceive of flying for commerical purposes. Some day, mails, parcel posts, light express, and thousands of commodities that now slow up the moving of heavier materials on our railroads will be carried more quickly and surely by air carriers.

Motor Trucks and Road Building

The motor truck industry is still in its infancy; it has not yet developed into what it is likely to be. We are not going to continue loading and unloading four times for short hauls when two are sufficient, especially when the elimination of short hauls by means of trucks will greatly facilitate long hauls by means of the railroads. The development of the truck industry, in turn, will also stimulate road building, and the building of roads will mean the development of other great businesses.

The industries mentioned above are those which are independent of the general uncertainty and which must develop because of public necessity compelling almost immediate attention as soon as present war conditions are out of the way. The machine tool business is always a reflection of the general business. Pig iron is the basis of every industry and the foundry is the fabricator of every tool used in all industries.

The Demand from Abroad

There is no doubt that there will be a considerable demand for machine tools from Belgium and France. It will take a great deal of both machine tools and other machinery and supplies to put these countries in a position where they can build and produce for themselves. There is little or no machinery at all left in all of Belgium, and northern France is in the same position. While there may be statesmen abroad who believe that their nations ought to produce for themselves all the machinery that they require within the next two or three years, every man acquainted with industrial conditions knows that this is absolutely impossible, and that for some years to come they must be heavy buyers if they wish to quickly regain their industrial position.

Importance of Public Policy

Now, how can we develop our legitimate industries, extend the market for our products, and keep our transportation system and our new merchant marine busy? We must see to it that our laws are so framed along the lines of the recent Webb Bill, that they facilitate legitimate combinations for developing foreign trade. Other nations are taking steps to assist their industries to secure markets abroad, and similar steps must be taken by our Government.

We have also the great task before us of assimilating the warring ideas of labor and capital, but if we have defeated civilization's mightiest enemy, we will not fail to establish peace within our own borders. The best elements of labor and the best elements of capital are nearer together now than they have been since the days of small business, when the employer was, in a sense, the big brother of his employes. For this and other reasons, there is no serious cause for apprehension.

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MOTOR TRUCK TRANSPORTATION

In a recent number, the *Scientific American* calls attention to the saving of time and expense in handling goods, which results from the employment of motor truck transportation, as compared with the practice of shipping goods by rail. The motor truck picks up a load at the door of the producer and delivers it directly at the door of the consumer; consequently the goods have to be handled but twice instead of four or more times, as is the case when a shipment is made by rail.

PROCESS OF CASTING FORMED CUTTING TOOLS

The Davidson process of casting formed tools was the subject of an interesting paper presented by J. E. Johnson, Jr., before the American Institute of Mining Engineers. By this process, such tools as high-speed steel milling cutters, reamers, countersinks, etc., are cast, the molten steel being poured into suitable molds so that the cutting teeth are formed by the mold and the expensive rough-machining operations are avoided. The teeth of these cast cutters are finished simply by grinding. After the cutters are taken from the mold they are annealed, and then any machining operations that may be necessary are performed. The tools are next hardened and ground. In the paper referred to, mention was made of three difficulties that are encountered when an attempt is made to cast high-speed steel cutters, if ordinary steel melting practice is adopted. The first difficulty is that of "killing" the steel to the point where castings can be made that are free from blow-holes. The second difficulty is that of producing a metal fluid enough to flow into the small parts of the mold and form sharp, clean-cut castings. The third difficulty mentioned is that of obtaining a satisfactory physical structure. The success of the Davidson process is said to be based largely upon the secret method of killing the steel, and the method of heat-treatment. The notable features resulting from the process are freedom from blow-holes, fluidity of the metal sufficient for obtaining excellent castings, even of small cutters, and absence of coarse crystallization in the casting.

Many tests have been made of these cast tools, which are the product of the Davidson Tool Mfg. Corporation, 118 Maiden Lane, New York City, and it is claimed that these tests show that the cast tools are highly satisfactory.

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MEETING OF THE GEAR ASSOCIATION STANDARDIZATION COMMITTEE

The Standardization Committee of the American Gear Manufacturers Association met at Hotel Statler, Buffalo, N. Y., February 10 and 11. Twenty-five members of the various standardization committees were present, every committee having representatives in attendance. A well-defined program was laid out for future activities, and all phases of the subject of gear standardization were discussed, it being apparent that much thought had been given to the subject. All committees were urged to seek the cooperation of other organizations interested in the standardization of gears, which is one of the most important subjects that the automotive industries will consider during the reconstruction period. The undertaking requires the serious cooperation of every gear manufacturer in the country. It is probable that a great advance toward the standardization of some classes and types of gearing will be made by the time of the annual meeting of the American Gear Manufacturers Association which will be held some time in April, probably in Cleveland.

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ANNUAL MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS

At the annual meeting of the Society of Automotive Engineers, held at the Engineering Societies' Bldg., February 4-6, a number of interesting papers relating both to the developments of the automobile, truck, and aeronautic industries during the war and to the future of these industries were read. Attention was given to such varied subjects as tanks used in warfare, farm tractors, gasoline marine engines, trucks, fuels for internal combustion engines, and engine design in relation to both automobiles and aircraft. A great number of the most prominent men in the automotive field were present at the meeting, which was held simultaneously with an exhibition of automobiles arranged by the automobile dealers of New York City.

American Machine Tools in France

THE American machine tool trade with France has been curtailed considerably by the attitude of the French Government toward the importation of foreign-made machine tools. French dealers who have requested permission to import American machine tools have had the size of their orders materially reduced and have not been permitted to order any machines to be carried in stock. This places them, as well as the French industries that require machine tools, at a disadvantage, and prevents the rapid readjustment of the country to prosperous peace conditions.

Present Requirements for Machine Tools in France

In the February number of MACHINERY, page 559, a review was given of the amount of machine tools needed in France during the years 1919 and 1920. The total amount of machine tools needed, according to the estimate there given, was valued at from $35,000,000 to $40,000,000 a year, of which from $20,000,000 to $25,000,000 worth a year would have to be imported from abroad. Another estimate that has been made by the French Government, in conjunction with machine tool dealers and builders in France, places the value of the machine tools that will be needed in France in 1919, for re-equipping the machine shops in the devastated regions and for taking care of the transformation of French factories from war to peace conditions, at $40,000,000. It is estimated that this requirement will be met partly by acquiring the American machine tools imported into France by the United States Government, which it is understood will be divided between Belgium and France. It is estimated that, of these machines, about $4,000,000 worth will be available for France. It is further estimated that the machine tool building industries in France are capable of producing machine tools to a value of $8,000,000. In addition, there are a number of machine tools, more or less used, that were employed in the ammunition and ordnance factories during the war, of which a great number may be used for peace industries. The value of these machines it is difficult to estimate, but possibly it would run up to from $10,000,000 to $15,000,000. This estimate still leaves from $13,000,000 to $18,000,000 worth of machine tools that must be imported during 1919.

French Official Opinion Overestimates France's Productive Capacity for Machine Tools

It is stated that the French Government takes the position that as France has accomplished some wonderful feats in manufacturing during the war, French manufacturers would be able to supply practically all the machine tools needed in the country during the period of reconstruction. It has been authoritatively stated that, if the French manufacturers estimate that they can produce $8,000,000 worth of machine tools in 1919, they probably could, by the same efforts as they exhibited during the war period—which efforts are still necessary in order to quickly rehabilitate a country that has suffered so much—manufacture machine tools to a value of from $20,000,000 to $25,000,000 in a year. That this belief is erroneous, however, American machine tool builders and others familiar with the machine tool industry will readily acknowledge.

Reasons Why France Cannot Supply All the Machine Tools Required at Once

It is true that during the war the French manufacturers have given proof of remarkable enterprise, ingenuity, and ability. Nevertheless, if they believe that they can at once turn their factories into great machine tool producing plants that will turn out machines that can compete in quality with the best grade of American-made machines, they do not fully understand the problem that they are undertaking to solve. Machine tools cannot be manufactured with the precision, accuracy, and care required by an organization that has sprung into being over night. Even if we disregard the time required for working out satisfactory designs, making patterns, and organizing for production, long and careful study must be given to the design and making of jigs, fixtures, and other equipment, and considerable experience is required in obtaining the precision and adjustments without which machine tools are next to worthless for high-class manufacturing purposes.

American machine tool manufacturers know how it has required, in many cases, not one or two years, but a great many years to develop a single satisfactory design, and as many years to produce an organization that would properly translate the design, so to speak, into a perfect mechanism of iron and steel. A great many concerns in this country who have undertaken to build machine tools and to compete with established firms without having the required experience and knowledge of the business, have failed. If French manufacturers—lacking this experience and knowledge—attempt at once to enter into machine tool building on a large scale they will not be able to obtain the results which will be necessary to quickly place France again in the economic position to which she is entitled because of the great sacrifices that she has made during the war.

It would, therefore, seem a great mistake, should the French Government continue to insist that the required amount of machine tools can be manufactured within the French borders. Some day, doubtless, France will be able to supply her own machine tool market, but that day has not yet arrived, and meanwhile any effort to restrict the importation of machine tools into France merely delays the reconstruction work so necessary for a nation that has suffered and lost so much.

Some Machine Tools that France Would Have Great Difficulty in Producing

Among the machine tools that France could not produce at all, or at least could not produce economically, are those which are used in small quantities in France and which cannot be built to advantage except by manufacturers who depend on the whole world as a market for their products. In this class are such machines as are not considered standard machine tools, but which are rather special in their nature, and closely allied with this group are the various kinds of automatic machines which can be built advantageously only when produced in great quantities. As another example may be mentioned milling machines. While the French Government hopes that two of the large well-known French makers would be able to supply the total requirements of France for milling machines during 1919, it has been pointed out that, although these firms have a good reputation as machine tool builders, they certainly could not attempt to produce machines of the same precision, capacity, and quality as the well-known makers of milling machines in the United States, who have devoted many years to obtaining their present experience and ability in both designing and building machines of this type. A similar comparison could be made with regard to at least half a dozen different standard machine tools manufactured in the United States, but the examples given will suffice.

Probable Result of Present French Policy

It is quite evident that, if the French Government continues to pursue the policy of refusing importation licenses for American machine tools or reducing the number of

licenses to a minimum on the principle that France can supply her own needs for machines of this kind, a great mistake will be made, and the welfare of France will not be well served, although the intentions may be of the best. Instead of placing up-to-date machine tools in the French shops at once, making it possible for the French manufacturers of numerous articles, devices, and machines to go to work immediately in an efficient manner manufacturing thousands of different articles that are needed in France, it would take two or three years, or more, before the French machine shops and factories would be properly equipped so as to be able to produce with the highest degree of efficiency. It is easily understood that the French Government aims to reduce all imports as much as possible, because of the enormous debt under which France labors, but it may be said, without hesitation, that the step taken to reduce machine tool imports is an erroneous one.

The Policy Urged by Those Who Thoroughly Understand French Conditions

If France is to quickly repay her debt, the most important thing is that the industries of the nation be made just as efficient as possible within the shortest possible time, and this can be done only by placing in the shops and factories the best kinds of machine tools at once. In order to do that, the doors must be opened and manufacturers must be permitted to buy the foreign-made machine tools that they require. Naturally, the bulk of these machine tools would have to come from America.

If this policy were pursued, it is reasonably certain that even a larger amount of American machine tools than estimated would pass into France, In fact, responsible dealers believe that France could advantageously absorb as much as $30,000,000 worth of machine tools and $10,000,000 worth of small tools within a very short period of time. At present, however, neither machine tools nor small tools can enter France without a special import license, and thus far all applications for import licenses for stock orders have been refused, which means that when a French manufacturer places an order with a French dealer he must wait until the license has been allowed, the machines ordered in the United States, and shipped to France. The delay and the economic loss to France from such a procedure is evident, and it is only in the interest of France to say that it is to be hoped this policy will soon be changed.

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CONFERENCE ON AMERICANIZATION IN THE INDUSTRIES

The recent meeting of the Inter-Racial Council in New York was typical of America, in that it included, in addition to men of distinction in finance, industry, and commerce, also leaders of organized labor and men eminent in science, education, and politics, while the foreign-born living in the United States had spokesmen of their own nationality to voice their views and to express their aspirations. The necessity for such a council was made apparent by the rumors concerning discontent among the foreign-born people in the United States. It has been estimated that a million of these men and women will leave America at the first opportunity. Why such a desire should exist among them is answered by the statement that the development of new republics in Europe has unsettled the belief that America is the "land of promise," and that millions of immigrants feel renewed interest in their former homes and indifference toward this country. It is also stated that a great deal of the savings of these people goes back to Europe and that little is done to check this drain upon our resources. The questions naturally arise: To what extent are these statements correct? What effect will all this have upon American industry? What are American business men going to do about it?

Questions such as these are of vital importance to leaders of American commerce and industry. They are of interest to everyone, but are of supreme importance to the employer of labor. If this country is to pass through a sane reconstruction period, without violence, anarchy, or civil strife, it will be necessary for us to understand fully facts like the following, and then to act upon them with intelligence and justice. In America we have 33,000,000 foreign-born or of foreign parentage. We have thirty-six races, speaking as many languages. Many of them are hostile to each other and indifferent to America. When the war began, it was discovered that 3,000,000 persons here did not speak our language and 6,000,000 were without American contacts, or quite out of touch with the land in which they live. There are 1146 foreign language papers, 300 racial organizations of national scope and 23,000 local organizations. We have foreign colonies in our cities and industrial towns. A general policy of indifference or worse exists toward the average foreign laborer, leaving him to the mercy of slum landlords, labor exploiters and swindlers of all sorts. Such are the facts.

In the new period into which we are entering, we must harmonize all these elements, if our nation is to hold together. Our problems are henceforth inter-racial, and the business man should enlarge his horizon accordingly. The Inter-Racial Council is the beginning of this new movement. Its program is clear-cut and practical:

First, the immigrant is to have every inducement to acquire the English language and learn what America stands for; to learn its ideals, its form of government, and its customs. Only by such elementary education in Americanism, can the foreign-born become one of us.

Second, the immigrant is to receive the same fair treatment by employers as is accorded the native-born worker able to protect himself. Not exploitation of immigrant labor, but friendly cooperation must be the future course, and the foreign-born must have this policy made evident both by words and deeds. The suppression of racial customs or language is not contemplated, for the foreigner brings us much that is desirable in the culture of the Old World.

Third, harmonious relations are to be promoted between the various racial groups in America, so that the foreign groups here may establish friendly contacts with each other as well as with native Americans.

It is proposed that the United States Government shall take a hand in this work, under the direction of the Secretary of the Interior, Franklin K. Lane. In a bill presented to Congress this session, the education of native illiterates, and of persons unable to understand the English language of foreign birth is proposed, and an annual appropriation of $12,500,000 is asked for, to carry on this important work. Such legislation is in direct accordance with the aims of the Inter-Racial Council.

* * *

GOVERNMENT, IN CONTROL OF RAILROADS, SHOULD BEGIN TO BUY

If railway purchases were resumed, a great step would be taken toward solving many of the industrial problems that now face the industries. The deferment of railway purchases is impeding, and is going to impede, the process of readjustment to peace conditions in a greater degree than any other one cause. The Government's policy of deferring purchases for the railroads at this time sets an example which, if followed by other industries, tends to demoralize business, shatter organizations, and throw thousands of men out of employment. Inasmuch as the railroads are sadly in need of equipment of all kinds—rolling stock as well as shop equipment—it is difficult to understand why steps are not taken immediately to place the railroads in a first-class condition, now that the war is over and the industries of the country are in a position to meet the requirements and the demands of railroad buying. With the railroads again in the market, there would be a revival of industry that would preclude any fear of decline in business.

Disposal of Government-owned Machine Tools

BY A. E. NEWTON

Vice-president and General Manager, Reed-Prentice Co., Worcester, Mass.
President, National Machine Tool Builders' Association

The problems that affect the machine tool industry do not concern this industry alone, but are of importance to all the machine building and mechanical industries of the nation, because of the basic and fundamental character of the machine tool business. The satisfactory solution of the most important problem now facing machine tool builders, therefore, is of interest to all; and the solution advocated by Mr. Newton is one which would greatly aid all other machine industries in their future development.

OF the many important questions now confronting the manufacturers of machine tools in the United States, there is no question that is of greater importance or that has more far-reaching consequences than that of the disposal of the large quantity of machine tools owned by the United States Government and released through the cessation of hostilities. On the manner in which these machine tools are disposed of by the War Department will depend largely the immediate future of the machine tool industry in the United States, and also in a wider sense the prosperity and welfare of the machine building industries and the mechanical industries in general. Why this is so will be made clear by considering a few fundamental facts in connection with the machine tool industry.

The Machine Tool Industry is the Fundamental Mechanical Industry

It is a well-known fact, often stated during the war, and definitely proved by the experiences in the manufacture of war materials, that the machine tool industry is the fundamental industry in the manufacture of everything that is made from metals. This is true not only from the point of view that machine tools are used in the manufacture of all articles, devices, and machines that are made from iron or steel or other metals, but it is also true in the sense that the machine tool industry has been the educational industry from which many of the leading mechanics in the other machine building industries have sprung. The machine tool manufacturer has provided not only the means whereby the great machine building industries of the nation have been built up, but in many instances he has also provided the processes and methods used in other plants than his own, and has educated and trained the mechanics that have become the foremen and superintendents in other machine-building plants. To cripple this great industry by disposing of the large quantity of machine tools that is now in the hands of the Government in such a manner that the industry would suffer a serious set-back for years to come would be extremely harmful, therefore, to all industries and to the general prosperity of the whole nation. A method of disposing of this large quantity of machines so that they are removed from competition with the builders of machine tools and at the same time serve a useful purpose in the building up of the future industries of the country is to be welcomed.

Equipping the Trade Schools with Modern Machine Tools is the Best Solution of the Problem

The idea embodied in the bill introduced in Congress by Representative Charles Pope Caldwell of New York to provide for further educational facilities along mechanical lines in the trade and technical schools of the country by making use of the government-owned machine tools for this purpose is therefore of the greatest importance. The value of distributing modern machine tools to the schools that educate our future mechanical men cannot be overestimated. There is a constantly growing demand for mechanics; a demand which annually grows greater. We live in a mechanical age and the further our civilization develops, the more needs are created that can be filled only from the mechanical and machine-building industries and by the training of men to enter these industries as efficient workers. An example of the growing demand for machinery may be seen in the extensive use of mechanical devices in the routine work of our homes, and in the increasing use of machinery on the farms. Electrical and mechanical devices of all kinds are now used in housekeeping, home-making, farming and, practically speaking, in all forms of useful activity. The manufacture of all this vast amount of machinery will constantly call for more trained men, and to properly train men, trade and technical schools are necessary.

Modern Equipment Needed in Trade Schools

One of the drawbacks of the technical and trade schools in the past has been that they have not been equipped with modern machine tools. An unusual opportunity, therefore, now presents itself to give to these schools additional up-to-date equipment. The bill to lend to the trade schools the machine tools now in the hands of the Government with the understanding that if the Government ever needs these machines again they can be requisitioned, should meet with the approval both of the machine tool builders and of the public in general; and in addition, it solves the immediate problem of the machine tool builders, removing from the open market at this time the large surplus of machine tools.

It is evident that there are some classes of machine tools in the hands of the Government that would not be suitable for the trade schools, especially large and special machinery intended particularly for the manufacture of heavy ordnance. These machines could well be turned over to the arsenals and navy yards, in many of which much of the equipment is old-fashioned and inefficient. In this way all the machinery that the Government has would be turned into purposes for which it is required and, in as far as the trade schools are concerned, to a purpose which would be of inestimable value to the country at large for many years to come.

Government Inventory of Machine Tools

The office of Director of Sales is planning to complete as soon as possible its inventory of the machine tools owned by the War Department so as to give the manufacturers an idea of the actual number of machine tools of each kind and class available. Without this inventory completed in every detail, it is, of course, impossible for the machine tool manufacturers to decide upon just what they could do with regard to disposing of the government-owned machine tools in conjunction with their own product, which is another proposition that has been made, but which is not as satisfactory by far as that of equipping trade and technical schools.

* * *

The National Foreign Trade Council will hold its sixth convention at the Congress Hotel, Chicago, April 24-26. The chairman of the council is James A. Farrell, president of the United States Steel Corporation. The main topic of the convention will be "Foreign Trade as a Factor in Stabilizing American Industry."

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Bliss Flat Edge Trimmer. E. W. Bliss Co., Brooklyn, N. Y.. 657
Blanchard No. 10 Surface Grinding Machine. Blanchard Machine Co., 64 State St., Cambridge, Mass..... 659
Graduated Precision Grinding Attachment. Precision & Thread Grinder Mfg. Co., 1932 Arch St., Philadelphia, Pa... 660
Barnes Sliding-head Gang Drilling Machine. Barnes Drill Co., 814 Chestnut St., Rockford, Ill..... 660
Fulflo Centrifugal Pumps. Fulflo Pump Co., Blanchester, O... 661
Heyen Machine for Corrugating Galvanized Iron Barrels. D. & O. G. Heyen, 8 Arlington Ave., Brooklyn, N. Y..... 661
Fischer Oil-grooving Machine. Fischer Machine Co., Philadelphia, Pa. 662
"Avey" Radial Drilling Machine. Cincinnati Pulley Machinery Co., Cincinnati, Ohio..... 663
Jahant Swivel Vise. Jahant Foundry & Heating Co., 148 Steiner Ave., Akron, Ohio..... 663
Queen City Shaper Countershaft. Queen City Machine Tool Co., Cincinnati, Ohio..... 663
Fortney "Mini" Plug Gages. Fortney Mfg. Co., 120 Malone Ave., Belleville, N. J..... 663
Westinghouse Polishing and Grinding Motors. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa..... 664
Perfection Relieving Attachment. Perfection Machine Works, Inc., 16-18 Norris Ave., Buffalo, N. Y..... 664
Coates Portable Die-sinking Machine. Coates Clipper Mfg. Co., Worcester, Mass..... 664
Electric Brazing Machine. Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York City..... 665
Wagenhorst Electric Blueprinter. J. H. Wagenhorst & Co., Youngstown, Ohio 665
Hartog Piston Chuck. S. D. Hartog Mfg. Co., St. Louis, Mo.. 666
Indicating Calipers. Indicating Calipers Co., 506 E. 19th St., New York City..... 666
Kent Bar Stock Racks. Kent Machine Co., Kent, Ohio..... 667
Modern Die-sinking Machine. Modern Mfg. Co., 75 Third St., Bridgeport, Conn..... 667
Lenox Metal-Cutting Band Saw. American Saw & Mfg. Co., Springfield, Mass..... 667
Wallace Bench Sawing Machine. J. D. Wallace & Co., 1401 W. Jackson Blvd., Chicago, Ill..... 668
Spafford Quick-acting Vise. Spafford Tool Works, 10 Hoadley Place, Hartford, Conn..... 668
Monarch Engine Lathes. Monarch Machine Tool Co., Sidney, Ohio 668
Black & Decker Valve Grinder. Black & Decker Mfg. Co., 10 Guilford Ave., Baltimore, Md..... 669
Canton Automobile Engine Floor Crane. Canton Foundry & Machine Co., Canton, Ohio..... 669
Petterson Drill and Valve Grinder. Petterson Engineering & Mfg. Co., 311 Main St., Worcester, Mass..... 669
Springfield Oscillating Surface Grinder. Springfield Mfg. Co., Bridgeport, Conn. 670
Putnam Slotting Machine. Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass..... 670
Black & Decker "Lectroflater" Outfit. Black & Decker Mfg. Co., 10 Guilford Ave., Baltimore, Md..... 671
Ideal Metal Cleaning Machine. Ideal Concrete Machinery Co., Cincinnati, Ohio..... 671
Defiance Cylinder Boring Machines. Defiance Machine Works, Defiance, Ohio 672
Electric Demagnetizing Machine. Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York City..... 672

BLISS FLAT EDGE TRIMMER

IN the process of manufacturing flat ware, which is the trade name applied to spoons, forks, knives, etc., there are many cases in which a shell or some concave member is drawn up under a power press, leaving a flash around the edge of the work. Various means could be employed for the removal of this excess metal, although the usual practice is to remove it with a trimming die. There are many cases where this procedure proves unsatisfactory, however, important among which are those instances where it is necessary to trim the edges of the two halves of silver knife

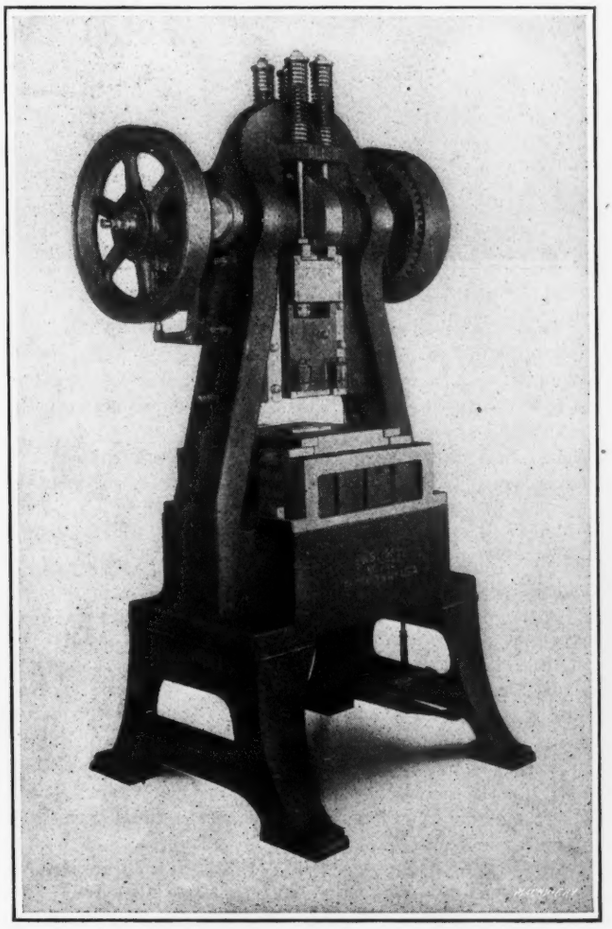


Fig. 1. Flat Edge Trimmer made by the E. W. Bliss Co.

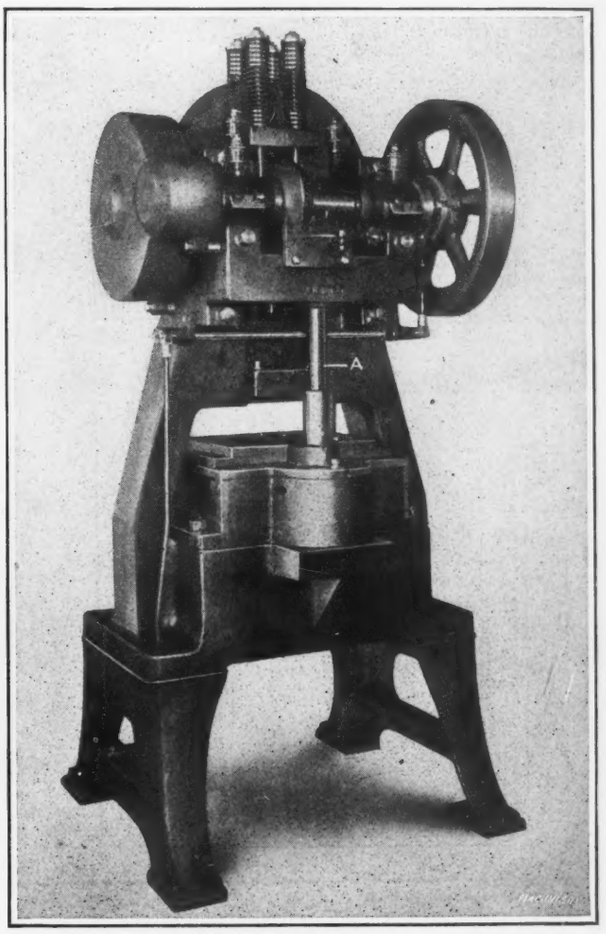


Fig. 2. Opposite Side of the E. W. Bliss Flat Edge Trimmer

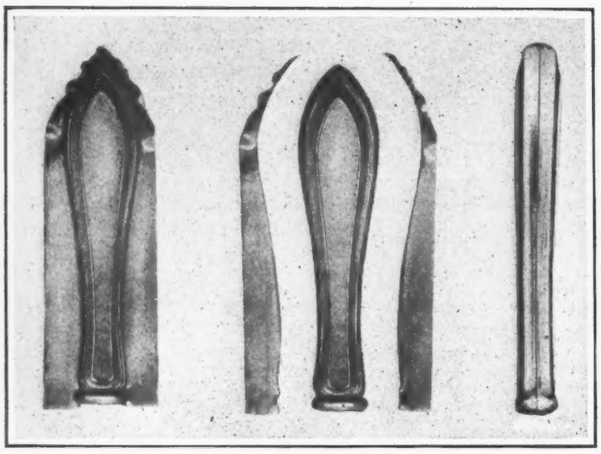


Fig. 3. Stamping for Half of Knife Handle before and after trimming Joint; also, Two Halves set together to show Perfection of Joint that is obtained

handles, or similar parts, preparatory to fitting them together. If a plain trimming die is used, it rolls up a slight fin along the edge of the work, making it impossible for the two halves to fit together ready for soldering without first finishing the edges on a disk grinder or some similar machine.

In order to overcome this difficulty, C. R. Gabriel of the E. W. Bliss Co., Brooklyn, N. Y., has developed a machine and method for the performance of this operation, and that firm is now building the machine for the market. Before entering upon a detailed explanation of features of the design of the mechanism of this power press and of the means provided for the performance of trimming operations, the reader will obtain a good idea of exactly the service which is performed by referring to Fig. 3, which shows half of a silver knife handle before and after trimming off the flash, and also the two halves of one of these handles laid together before any subsequent work has been done on the joint. This illustration bears testimony to the perfection of workmanship which is attained. It will be apparent by reference to the joint that there are no burrs

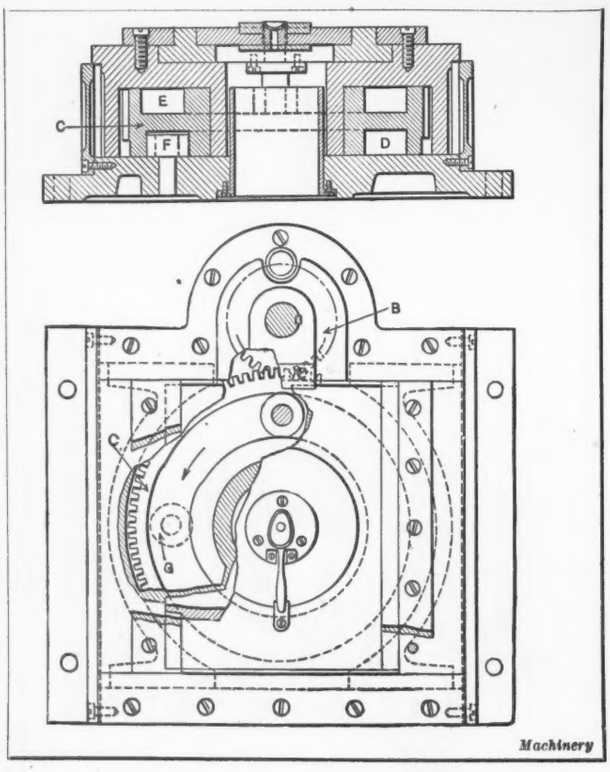


Fig. 4. Mechanism which transmits Reciprocating Motion to Trimming Dies

or other irregularities on the trimmed edges of the two halves of the work, for if any such obstructions had been produced, it would have been manifestly impossible for the two halves to come together as they do. The edges have received no subsequent treatment after trimming.

Two views of the flat edge trimmer are shown in Figs. 1 and 2, and Fig. 4 shows a cross-sectional view through the lower die and its actuating mechanism. It must be understood that at the time the work is delivered to one of these machines it has been drawn up and is ready to have the surplus metal trimmed from the edge. This result is accomplished by having the lower die of the trimming press formed to receive the work and what is known as a "filler piece," which corresponds exactly in shape and size to the male die or force that is used to draw up the work during the preceding operation. When the stamping has been dropped into place in the lower die of the trimming machine and the filler piece has been put into place, the power press is tripped, causing the upper die member to descend onto the work. This die remains in the "down" position for a sufficient length of time to allow the shearing of excess metal from around the edge of the work to be accomplished. This is done by causing the lower die, in which the work is held,

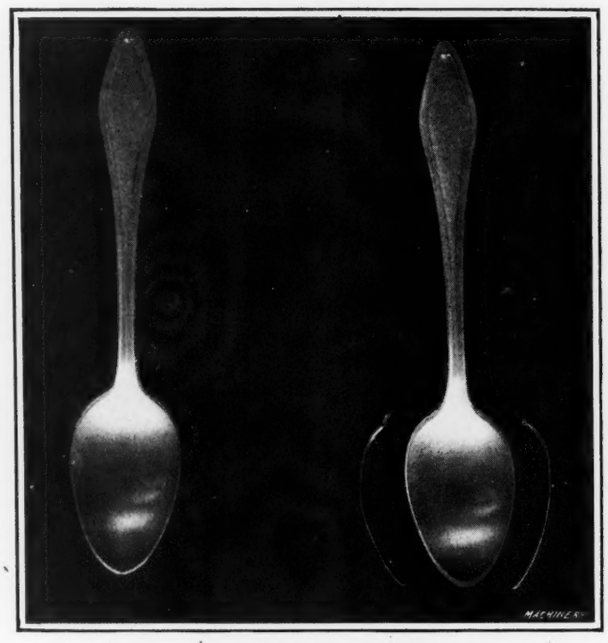


Fig. 5. Bowl of Spoon before and after trimming off the Flash

to reciprocate first forward, next backward, then to the right, and finally to the left, these four movements being accomplished by means of a cam mechanism, the arrangement of which is shown in Fig. 4. The work is sheared between the edges of the upper and lower dies.

At the back of the machine in Fig. 2 there will be seen a vertical shaft *A* which carries pinion *B*, Fig. 4, at its lower end. It will be apparent that this pinion meshes with gear *C*, which has cam grooves *D* and *E* cut in its lower and upper faces. The right and left sliding movement of the lower trimming die is accomplished by means of the lower cam groove *D*, while its forward and backward sliding movement is accomplished by cam groove *E*. It will be noticed from Fig. 4 that gear *C* rotates upon a bearing attached to the lower member of the slide, and that roller *F* is secured to the stationary bed of the machine. As gear *C* rotates, roller *F* first engages a section of the cam groove, which causes the trimming die to move to the right, and then comes into a second section of the groove, which causes the left movement of the die, after which the die returns to its neutral position.

At that time, roller *F* enters a dwell in the cam groove so that further rotation of gear *C* is accomplished without roller *F* having any effect. At the same time that roller *F*

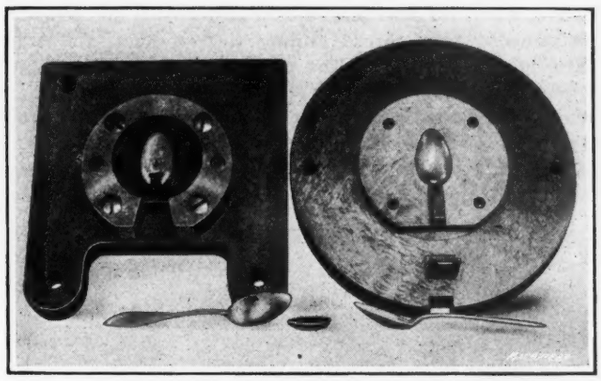


Fig. 6. Dies used for trimming Flash from Spoon Bowl as shown in Fig. 5

enters the dwell in its cam groove, roller *G* engages a section of the upper groove cut in gear *C*, that causes the trimming die to move first to the front, then to the rear, and finally back to the neutral position. It is this slight motion of the lower trimming die in contact with the upper die member which is responsible for shearing the excess metal off the edge of the work, and as the action is one of pure shear, with the metal fully supported by the upper and lower dies, there is no danger of producing a burr on the work, or of producing an irregular edge. Consequently, no subsequent operation, such as surface-grinding, is required.

The Bliss flat edge trimmer was first introduced in plants engaged in the manufacture of table silver. It is important to note, however, that its conception and design are based upon very broad principles. Drawn or formed shells of any kind that must have a perfectly flat edge, as, for example, metal boxes where box and lid are required to meet in a perfect joint, or metal shapes that are to be fitted against flat metal plates, can be trimmed by this method with entire success. In general, the statement may be made that it is well suited for use in handling all classes of work where it is desired to trim a rough edge, a flash, or any form of surplus metal from drawn shells and other concave shaped work of a similar character. Although those machines which have been placed in service are used for trimming relatively thin work, it will be apparent to the experienced engineer that the principles of design which are used in constructing the Bliss flat edge trimmer could be employed for the construction of presses having sufficient capacity to cut metal of considerable thickness.

BLANCHARD NO. 10 SURFACE GRINDING MACHINE

To meet the demand for a small sized machine built along the same general lines as the high-power vertical surface grinding machine of its manufacture, the Blanchard Machine Co., 64 State St., Cambridge, Mass., has placed a No. 10 grinder on the market. The design of this machine follows closely along the lines of the No. 16 size, but many details have been simplified where such changes were made possible by the smaller size and weight of the parts without reducing their efficiency. This smaller grinding machine is especially adapted for use in plants where it is necessary to grind pieces less than 18 inches in diameter, one at a time, or where dies, punches, and other small tools have to be ground in limited quantities. In general, the machine is adapted for use in surfacing directly from rough forgings or castings of parts for small jigs and fixtures, etc., preliminary to laying them out; for finishing parallel and square surfaces, removing from 1/16 to 1/8 inch of stock; and for the performance of many other operations of the same general character.

The bed of this grinding machine is of box form and cast in one piece, with webs to increase the rigidity. A three-point support on the base is provided for the column, with means of aligning it to bring the spindle square on the table. This three-point support of the column also provides for inclining the spindle when it is required to grind concave or convex work. A steel forging of 0.40 to 0.50 per cent carbon content is used for making the spindle, which is 2⅜ inches in diameter and mounted on two ball bearings, which provide for carrying both thrust and radial loads. A spring take-up mechanism automatically removes backlash and also compensates for temperature changes. The bearing mountings are so designed that they retain oil and exclude dirt without requiring the use of stuffing-boxes, felt packings, or similar devices.

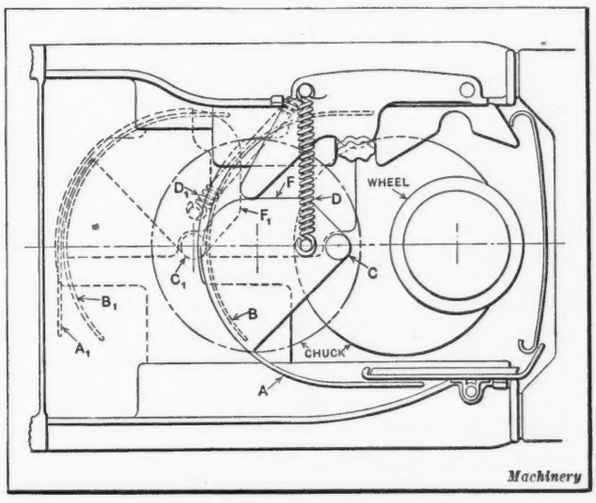


Fig. 1. Arrangement of Curved Steel Water Guards around Chuck of Blanchard Surface Grinding Machine

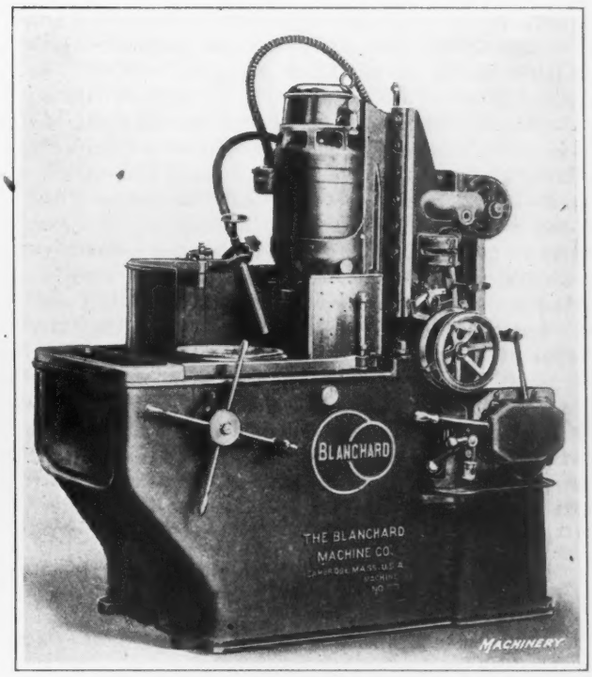


Fig. 2. No. 10 Surface Grinding Machine built by the Blanchard Machine Co.

Direct motor drive is used on this machine, a 10-horsepower induction motor which runs at 1740 revolutions per minute being mounted directly on the wheel-spindle, which also carries a fan to provide for forcing air through the motor and out between the back of the wheel-head and column. The chuck and water pump are driven separately from a smaller motor on the rear of the machine, these two motors being wired in such a way that they start and stop together. The electrically controlled parts comprise a hand auto-starter with no voltage release or overload relays. In addition, a belt-driven machine is built with an 8⅜-inch diameter drum pulley on the spindle which carries a 4-inch double belt that is entirely enclosed, the belt passing back

through openings cored in the column, so that the belt-driven machine is very similar in appearance to the direct motor-driven equipment.

Hand and power feeds are provided, the latter being adjustable from 0.0002 to 0.004 inch per revolution. A Blanchard one-piece steel magnetic chuck is used, which is made of a steel forging, and has no joints in its working face. The narrow ring poles hold even the smallest work without danger of slipping. The face of the chuck is made of steel and brass, and is claimed to give no trouble from becoming charged with grit. Provision is made for driving the chuck from a horizontal shaft at the rear of the machine, which connects with the chuck speed-box and water pump. This shaft is driven by a belt from the auxiliary motor in the case of the electrically driven machine, or from guide pulleys on the belt-driven machine. A submerged pump supplies water through separate pipes to the inside of the wheel and to the outside nozzle, so that the work can be flooded, while the water inside the wheel is forced through by centrifugal action, thus absorbing the heat practically as fast as it is generated. As a result, dies and other hardened tools can be ground at extremely high rates without danger of softening their cutting edges or producing surface cracks. In designing the base of the machine, provision has been made for having the water first fall into a tank from which the sludge carried by the water can be removed with a hoe.

By reference to Fig. 1, it will be seen that the sliding table, which carries the chuck also carries two curved steel guards; guard *A* is pivoted at *C*, and guard *B* is fixed to the table. Guard *A* tends to rotate under the action of spring *D*, but is controlled by cam *F* which forms part of the upper frame of guard *A*. This cam bears against a fixed projection on a casting at the rear. The solid lines show guard *A* and the chuck in the grinding position, where guards *A* and *B* are overlapped by straight guards at the sides of the machine, forming in combination with the guard behind the wheel a complete enclosure around the wheel and the work. When the grinding is completed, the chuck is moved out to the position shown by the dot and dash line, pivot *C* moving to C_1 and guard *B* to B_1. Guard *A*, controlled by spring *D* and cam *F*, swings around to position A_1, leaving a wide opening for removing and inserting the work.

GRADUATED PRECISION GRINDING ATTACHMENT

A graduated precision grinding attachment is now being made by the Precision & Thread Grinder Mfg. Co., 1932 Arch St., Philadelphia, Pa. It is adapted for use on lathes, milling machines, and other types of machine tools, and can be employed for the performance of a great variety of grinding operations. The grinding of thread gages to correct the distortion produced in hardening is one of the important applications of this attachment; but it may be employed for a variety of other grinding operations on threaded work, such as hardened steel screws used in precision and scientific instruments, taps, thread milling cutters, hobs, and other parts of a like nature. The machine is also well adapted for use on milling machines for the performance of surface grinding operations, and it can be set up on lathes or other types of machine tools to provide for grinding the interior of holes in dies, and other work. It has also been suggested that this equipment could be used to excellent advantage for grinding the commutators of electrical machines in order to refinish them and remove roughness resulting from service. The whole grinding attachment weighs only 50 pounds, so that it may be readily transported from place to place, which is an important feature when engaged in grinding such work as the commutators of electrical machinery, which require the grinding equipment to be taken to the machine.

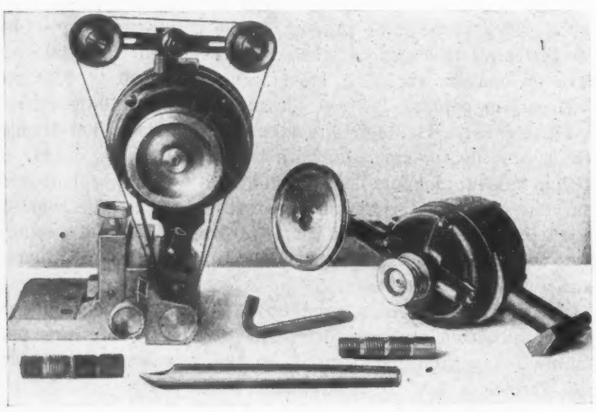


Fig. 1. Graduated Precision Grinding Attachment made by the Precision & Thread Grinder Mfg. Co.

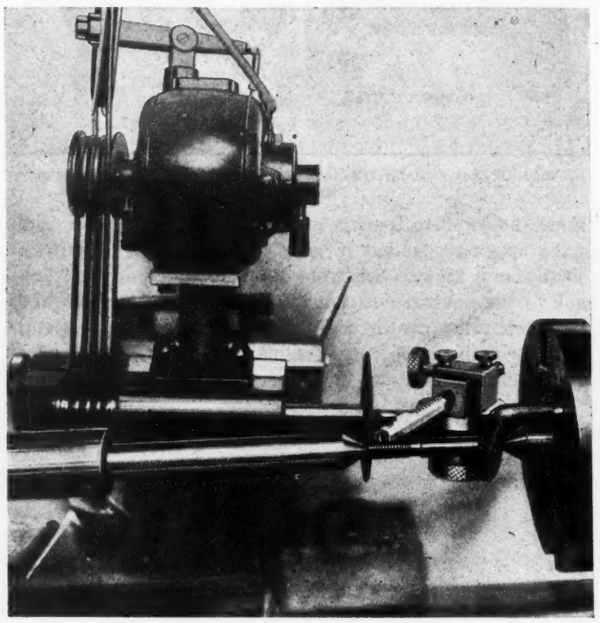


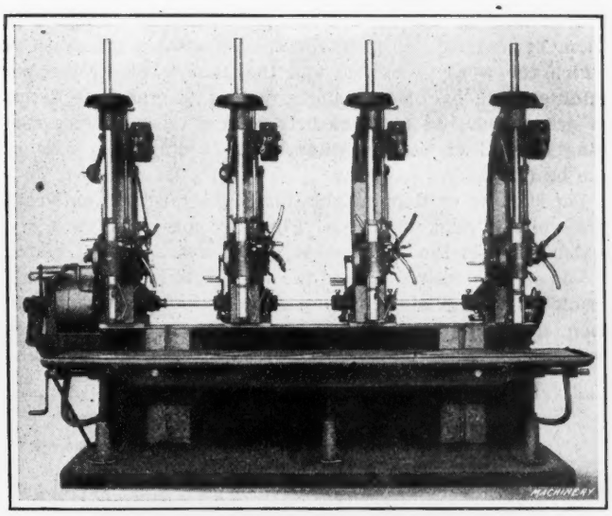
Fig. 2. Graduated Precision Grinding Attachment set up on a Lathe for performing a Thread Grinding Operation

It will be seen that provision is made for bolting the attachment to the lathe carriage (or to any type of machine on which it is used) and that an individual driving motor is employed from which the speed is increased sufficiently to furnish the required peripheral cutting speed for the grinding wheel. Speeds up to 15,000 revolutions per minute are available. An important feature of the driving mechanism is that vibration cannot be transmitted from the machine tool to the grinding wheel of the attachment, because the driving shaft is made independent of the main bearing shaft, allowing the wheel perfect freedom of operation. The grinding spindle is carried in Norma ball bearings mounted in dustproof cases. Owing to the helix angle of the thread on gages and similar work that is to be ground, it is necessary to set the grinding-wheel spindle at different angles according to the pitch of the thread on the work. Such adjustment is made by having the grinder head carried on a bracket pivoted to the body of the attachment. Three graduated adjustments are provided on the attachment for use in setting the wheel-spindle to conform with the helix angle of the thread to be ground, for raising or lowering the wheel-spindle, and for securing longitudinal adjustment of the wheel. In addition, there is a graduated wheel-truing device which may be set to control the direction of travel of the diamond point relative to the wheel, to provide for grinding any desired form of thread.

BARNES GANG DRILLING MACHINE

In the accompanying illustration is shown a 26-inch sliding-head gang drilling machine which is provided with lateral adjustment for the spindles. It will be apparent to

those who are familiar with the drilling machines built by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill., that this machine is of quite similar design to preceding tools built by the firm, the most important improvement consisting of the feature of lateral adjustment. This allows settings to be obtained on the four-spindle machine from a minimum distance of 18 inches between the centers of any two adjacent spindles up to a maximum distance of 96



Sliding-head 26-inch Gang Drilling Machine built by the Barnes Drill Co.

inches between the centers of the two outside spindles. Consequently, it will be seen that provision is made for enabling this machine to cover quite a wide range of work in which there is considerable variation of the center-to-center distance of holes.

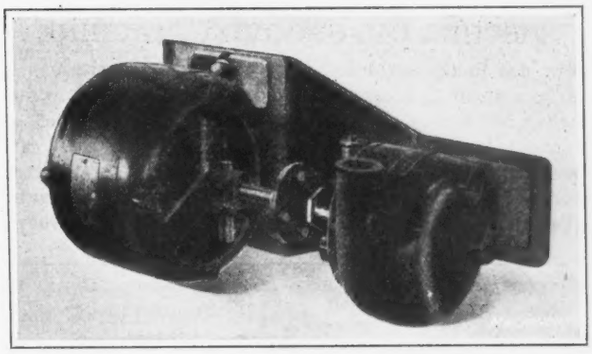
An important feature of construction is that all gears are made of steel, and those gears which are subjected to exceptionally severe service are heat-treated to assure their having the required strength and durability. The capacity of the machine is for driving twist drills up to 2 inches in diameter when working in steel, or it will perform boring operations in cylinders up to 8 inches in diameter. Other features of design conform with the preceding types of Barnes drilling machines, so that further description is not called for at this time.

FULFLO MOTOR-DRIVEN CENTRIFUGAL PUMPS

The Fulflo Pump Co., Blanchester, Ohio, has placed on the market a line of direct-connected motor-driven pumps which are designed for use in connection with motor-driven machine tools, oil circulating baths and for supplying batteries of machines with cutting oils or compound. These pumps are of the centrifugal type, but retain their prime without the aid of valves or other mechanical means, each pump being provided with a priming chamber and having both the intake and outlet located at the top, which makes it impossible for them to lose their prime. The impellers are of the semi-enclosed type, and are supported by a bearing at each end of the impeller shaft. All thrust load comes on the suction side of the impeller, and is taken care of by a hardened steel thrust collar on the impeller shaft, which bears against the nose of a bronze bushing supporting the impeller shaft on the suction side of the pump. The thrust at this point is very slight, as most of it is taken up by means of the coupling that is located between the pump shaft and the motor shaft.

On this pump, the main bearing also forms the pump gland, and it is made of cast iron, lubrication of this bearing being taken care of by a sight-feed oiler which feeds into a pocket completely surrounding the bearing. The shaft is of hardened and ground steel, and the packing used is of the flexible metallic type and is guaranteed not to cut the shaft. This pump has exceptionally long life, as the impeller, the only internal pumping part, does not depend on any contact fits for its pumping efficiency. Pumps of the standard design have cast-iron bodies, covers and impellers, but may be furnished in brass or bronze when so desired. The base is arranged for three-point mounting, which enables it to be leveled without the necessity of machining the surface to which it is to be attached. This is accomplished by six screws, three of which extend through the motor and pump base, and three through the motor base only, the pump base resting on their points. This makes it possible, by adjusting the screws, to bring the pump exactly in line with the motor, after which the screws are locked in place. The coupling used is the "Flexite" type manufactured by F. R. Blair & Co., and it is fastened to both the pump and motor shaft with Woodruff keys and set-screws. Robbins & Myers motors are regularly furnished for use with these machines, as part of the equipment.

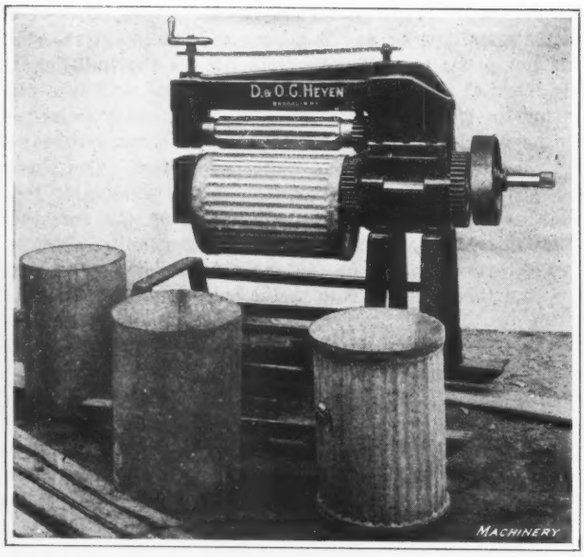
These outfits are made in four different sizes: (1) A ⅜-inch pump with 1/6-horsepower motor, having a maximum rating of five gallons per minute, an 18-inch suction without using a valve, and a 15-foot head lift. (2) A ¾-inch pump with 1/3-horsepower motor, having a maximum rating of 18 gallons per minute, a 12-inch suction without a valve, and a 20-foot head lift. (3) A 1-inch pump with ¾-horsepower motor, having a maximum rating of 27½ gallons per minute, an 18-inch suction without a valve, and a 40-foot head lift. (4) A 1¼-inch pump with 1-horsepower motor, having a maximum rating of 40 gallons per minute, an 18-inch suction without a valve, and a 40-foot head lift. These pumps can be furnished for either wall or floor mounting. The pump shown in the accompanying illustration is a ¾-inch size equipped with 1/3-horsepower motor running 2700 revolutions per minute. The over-all dimensions are as follows: length, 19⅜ inches; width, 8 inches; height, 9¼ inches; and weight complete, 58 pounds. Tests on twelve of these pumps showed the following average result: Speed 2700 revolutions per minute, 21 gallons per minute, 11-foot head; speed 2700 revolutions per minute, 20 gallons per minute, 12½-foot head; speed 2700 revolutions per minute, 11 gallons per minute, 24-foot head. Cutting compound was used in making these tests. These pumps can be furnished with motors of varying speeds and sizes to suit different conditions of service for which they may be required.



Centrifugal Cutting Oil Pump manufactured by the Fulflo Pump Co.

HEYEN MACHINE FOR CORRUGATING GALVANIZED IRON BARRELS

D. & O. G. Heyen, 8 Arlington Ave., Brooklyn, N. Y., have recently placed on the market a galvanized iron barrel corrugating machine which is here illustrated and described. Two barrels can be seen standing in front of the machine ready for the corrugating operation, and a third corrugated barrel is shown on the ground, in addition to the



Galvanized Iron Barrel Corrugating Machine built by D. & O. G. Heyen

one which is in place between the rolls. It will be apparent from this illustration that the method of procedure is to roll the blank for a barrel body to the desired form and fold the side seam. After this has been done, the work is placed between the corrugating rolls and the upper, or adjustable, roll is brought down into contact with the work by turning a handwheel which manipulates two adjusting screws through the medium of a sprocket drive. The machine is started running before the adjustable roll is moved down onto the work. An advantage claimed for this method of corrugating is that the operation serves the additional purpose of securely closing in the side seam on the barrel. It will be apparent from the illustration that power is transmitted from the driving shaft through back-gears, and that both the upper and lower corrugating rolls are provided with positive geared drives. Both the corrugating rolls and the driving gears are made of steel; and an idea of the rapidity with which the machine operates will be gathered from the fact that the barrels may be corrugated at the rate of one every three minutes.

FISCHER OIL-GROOVING MACHINE

For use in the performance of oil-grooving operations on bearings up to 15 inches in diameter by 15 inches long, the Fischer Machine Co., Philadelphia, Pa., has developed an improved type of machine which is here illustrated and described. It will be apparent that the design of this tool combines the standard features of construction of engine lathes and crank shapers. The bearing in which oil-grooves are to be cut is mounted on a revolving chuck or faceplate, and an Armstrong boring-bar is carried by a block mounted on a reciprocating slide. With this combination of movements for the tool and work, it is possible to produce a variety of different types of oil-grooves, typical examples of which are shown in Fig. 2. By holding the work stationary and reciprocating the tool-slide, a straight oil-groove may be cut parallel with the axis of the bearing; and by holding the tool-slide stationary and revolving the work, a round groove may be cut in a plane perpendicular to the axis. Then by making a proper adjustment between the speed at which the work is rotated and the number of strokes per minute made by the tool-slide, various intermediate forms of grooves may be obtained between the two extremes running parallel or perpendicular to the longitudinal axis of the bearing.

For starting or stopping rotation of the faceplate on which the work is held, handle *A*, Fig. 1, is provided on a rod which controls the engagement or disengagement of clutch *B*. When it is desired to hold the work without rotation, this result is accomplished by first disengaging the clutch and then clamping the spindle by means of binder *C*. Three variations may be made in the speed of rotation by means

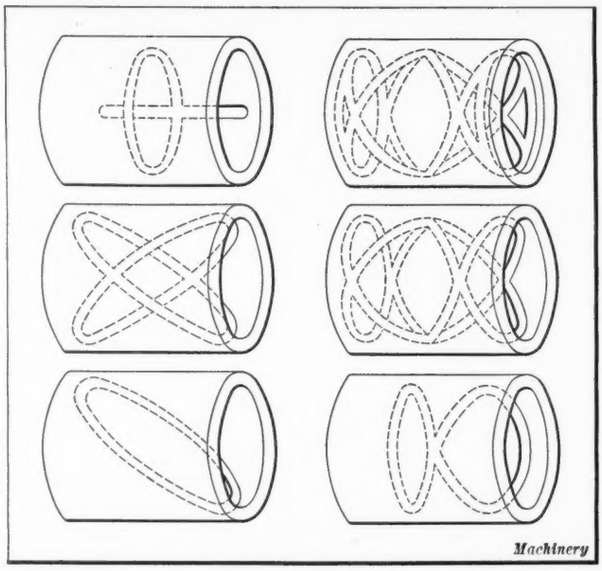


Fig. 2. Examples of Oil-grooving Operations performed on Machine shown in Fig. 1

of change-gears which are manipulated by lever *J*. All readers of MACHINERY are familiar with the mechanism of the crank shaper, and so the means provided for reciprocating the tool-slide on this oil-grooving machine needs no further explanation except to say that the construction is similar to that used on crank shapers of standard design. Adjustment of the length of stroke is obtained by a wrench placed over the squared end of shaft *D*, and an indicator on scale *E* shows when the desired length of stroke has been obtained. When it is required to hold the tool-slide stationary, it may be locked to the bed of the machine by means of a binder *F*. Obviously, a machine of this kind must be provided with adjustment for handling work of various diameters, and such adjustment is made by means of the cross-slide operated by a screw and ball-crank *G*. Longitudinal adjustment of the tool is also important, and this is accomplished by means of a crank on the squared end of shaft *H*. To provide for the performance of oil-grooving operations on tapered bearings, a taper attachment may be furnished. Oil-grooves may be cut on both internal and external bearings.

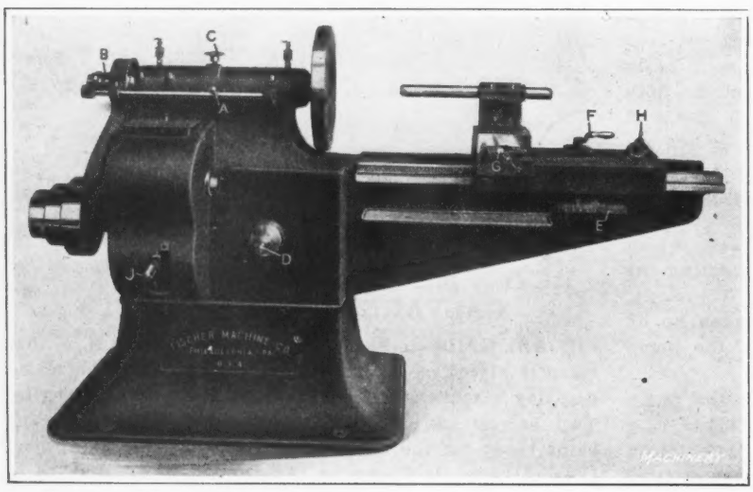
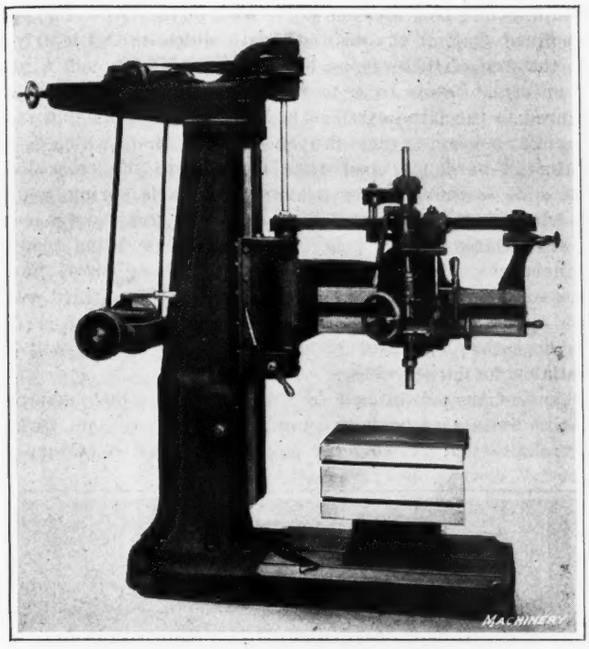


Fig. 1. Improved Type of Oil-grooving Machine built by the Fischer Machine Co.



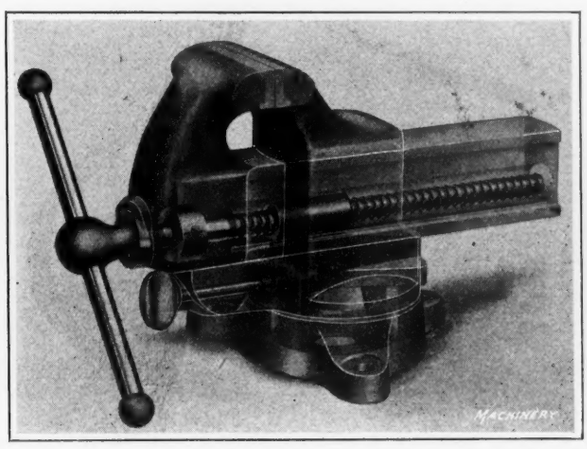
Sensitive Radial Drilling Machine built by the Cincinnati Pulley Machinery Co.

"AVEY" RADIAL DRILLING MACHINE

The sensitive radial drilling machine which forms the subject of the following description is a recent addition to the line of "Avey" drilling machines built by the Cincinnati Pulley Machinery Co., Cincinnati, Ohio. This machine is equipped with ball bearings throughout, and it is usually built with a plain hand feed and a tapping attachment, although a power feed mechanism can be provided when desired. The spindle has a vertical rack feed of 8 inches, and it has a No. 2 Morse taper which affords capacity for holding taper shank drills up to 29/32 inch in diameter. On the machine shown in the illustration, there is a 2½-foot radial arm, and sufficient capacity is provided to take work up to 48 inches under the spindle. Six changes of speed are available, three changes being obtained with the open belt and three by driving through back-gears on the countershaft. Four rates of feed are provided on machines equipped with a power feed mechanism, these changes being obtained through gears in a box conveniently located at the side of the machine.

JAHANT SWIVEL VISE

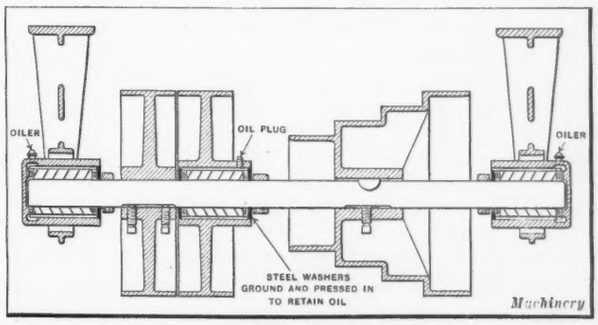
The "Wedg-lok" swivel vise which is here illustrated and described is a recent production of the Jahant Foundry & Heating Co., 148 Steiner Ave., Akron, Ohio. This vise may readily be adjusted to any angle which is most convenient for the workman, and the angle can be instantly changed. The vise proper is mounted in a circular socket hole in the base, and swings easily to any position around a complete circle. It is simply necessary to turn the vise to the most convenient position and tighten the jaws on the work, which also locks the vise in place. An angle locating nut at the back end of the jaw-locking screw provides for clamping the vise in any desired position. It wedges the vise securely into the base at the same time that the jaws are tightened. When it is required to change the position of the vise, it is merely necessary to release the screw, turn the vise as desired with one hand, and then retighten the screw. Hence, it will be apparent that adjusting the angle may be as quickly accomplished as tightening the jaws. A small thumb-screw at the front of the vise holds the locating nut firmly in the locked position when the vise is to be set permanently in one position. This does not interfere with the operation of the jaws in any way, and the vise can be permanently locked or released from its position by merely turning the screw.



"Wedg-lok" Swivel Vise manufactured by the Jahant Foundry & Heating Co.

QUEEN CITY SHAPER COUNTERSHAFT

After March 1, 1919, all shaping machines built by the Queen City Machine Tool Co., Cincinnati, Ohio, will be provided with countershafts that are fully equipped with Hyatt roller bearings. In the accompanying illustration is shown a longitudinal section through one of these countershafts,

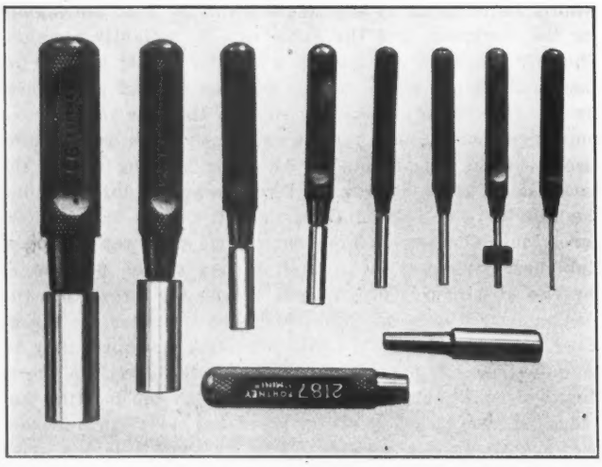


Queen City Shaper Countershaft equipped with Hyatt Roller Bearings

from which the reader will obtain a comprehensive idea of its design. It will be apparent that Hyatt roller bearings are provided for both hangers and for the loose pulley. The two hanger bearings are furnished with Fischer oilers, while the oil-hole in the loose pulley is provided with a threaded plug which may be screwed in to retain the oil as the pulley rotates. Other features of the countershaft do not call for a detailed description.

FORTNEY "MINI" PLUG GAGES

For the use of watchmakers, precision instrument makers, and other manufacturers who have work in which very small holes have to be gaged, the Fortney Mfg. Co., 120 Malone Ave., Belleville, N. J., is making a line of what are known as "mini" plug and ring gages of the general form shown in the accompanying illustration. The range of sizes runs from the smallest diameters in which holes are made by numbered drills up to 1 inch by intervals of 0.001 inch, the chief feature being the smaller sizes of gages which run below the minimum diameters in which plug and ring gages are ordinarily made for the market. It will be apparent that these plug gages are furnished with a knurled handle to facilitate holding them securely, and it is proposed to make stepped plugs for "Go" and "Not Go" gages with any required difference in diameter, according to the limits allowed in the dimensions of the work. In making "mini" gages over 1/16 inch in diameter, the plug is provided with a tapered shank which is driven into a corresponding tapered bore in the knurled handle, so that when a plug be-

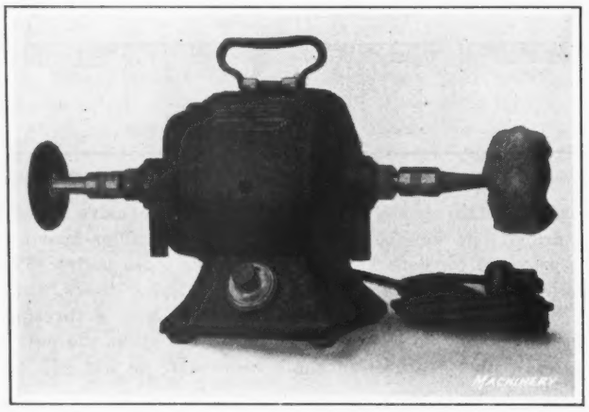


"Mini" Plug Gages made in Sizes from 0.020 to 1.000 Inch by the Fortney Mfg. Co.

comes worn it may be removed from the handle and a new one of the proper size substituted in its place. This allows manufacturers using these gages to replace those which are worn, at a smaller expense than would be involved if it were necessary to buy new handles at the same time that the plugs had to be replaced. These gages are guaranteed to be accurate to 0.00005 inch at 68 degrees F.

WESTINGHOUSE POLISHING AND GRINDING MOTORS

One of the recent products of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., is an electric motor with the armature spindle extended to provide for mounting grinding and buffing wheels at opposite ends. This outfit



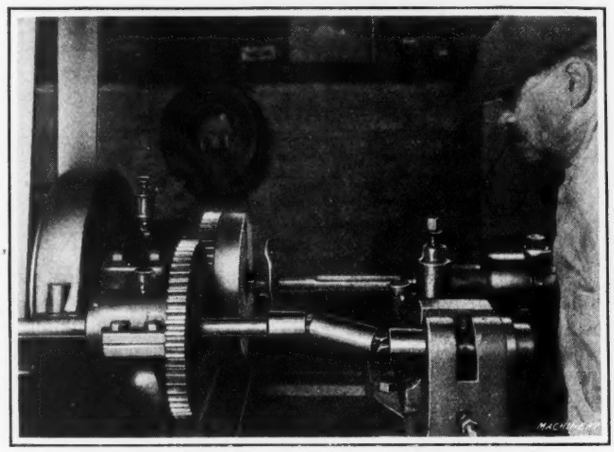
Polishing and Grinding Motor built by the Westinghouse Electric & Mfg. Co.

is adapted for use in manufacturing plants or repair shops where there are pieces of small or medium size to be ground or polished. Owing to the light weight of the machine, it may be easily moved about and used in any desired position. The motor is of a simple single-speed type, and is completely enclosed. The armature spindle is mounted in long dustproof bearings, and holes are drilled in the base to provide for fastening it down if the machine is to be permanently used in one position. A ten-foot cord and separable plug are furnished with the motor for making connection with an ordinary lamp socket.

RELIEVING ATTACHMENT

A relieving attachment manufactured by the Perfection Machine Works, Inc., 16-18 Norris Avenue, Buffalo, N. Y., which is adapted for use on any make of lathe, is shown in the accompanying illustration. In this device a bracket is secured to the lathe bed at a point close to the headstock; and mounted upon this bracket there is a gear which meshes with a second gear secured to the back of the lathe faceplate. A splined shaft of any desired length slides in, and is driven by, the first of these gears, and is connected through a pair of universal joints to a short shaft mounted in a bracket secured to the lathe carriage in place of the compound rest. A removable cam is carried upon the short shaft, which bears against a hardened steel plate fastened to the cross-slide. The slide is connected by a heavy adjustable spring, which holds the cam follower plate against the cam; and a cam of any desired outline may be used, one cam being readily changed for another. By using a second universal joint, face- or end-relieving operations may be accomplished with this device. This attachment has been manufactured for use on lathes up to 18 inches swing, and shortly will be available for larger sizes.

Some of the advantages of this relieving attachment are that no holes need be drilled in any part of the lathe. Owing to the direct drive from the spindle, it is not necessary to

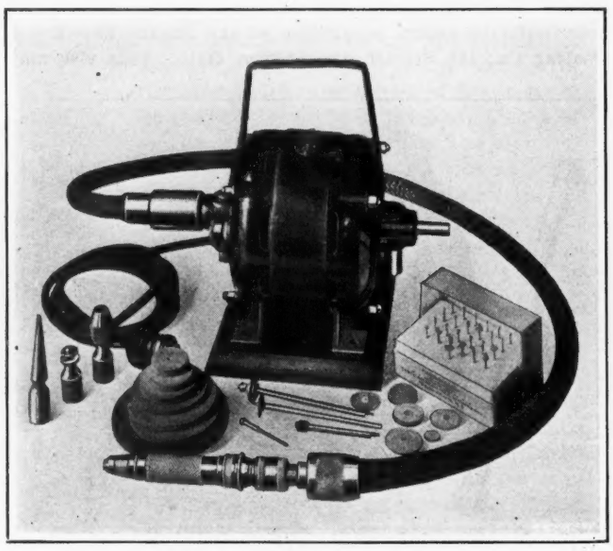


Relieving Attachment made by the Perfection Machine Works, Inc., for Use on Engine Lathes up to 18 Inches Swing

connect in any manner with the gear-box. No hollow shafts are used, and it is only necessary to provide a driving shaft of the proper length in order to use this attachment on any length of lathe. The construction is heavy and solid throughout, and no scraping is required in setting up.

COATES PORTABLE DIE-SINKING MACHINE

For use in the performance of die-sinking and similar operations, the Coates Clipper Mfg. Co., Worcester, Mass., is now building an improved type of electrically driven



Electrically Driven Portable Die-sinking Machine built by the Coates Clipper Mfg. Co.

portable grinding machine. This outfit is made in two sizes, the smaller of which is driven by a ⅛-horsepower motor and a three-foot Coates ¼-inch cable shaft contained in a braided cover. The equipment includes a nickel-plated hand-piece with a mandrel, six small abrasive wheels, and a box of twenty-five "dental" points. Three chucks are also provided for the performance of drilling, buffing, and grinding operations, respectively, in addition to which are furnished three grinding wheels of 1 inch, 1½ inch, and 2 inches in diameter by 3/16 inch thick, for use in the grinding chuck. This entire outfit weighs 20 pounds.

The larger machine is provided with a 4-foot Coates ⅜-inch cable shaft contained in a braided cover. With this outfit there are furnished a nickel-plated hand-piece and four mandrels, a box of twenty-five abrasive points of various sizes and coarseness of grain, and a full assortment of abrasive wheels to provide for meeting the requirements of the range of work which can be handled. The equipment also includes three chucks of the same type as those referred to in the preceding paragraph. The weight of the complete grinding outfit is 30 pounds.

ELECTRIC BRAZING MACHINE

There are a great variety of manufactured metal products on which brazing operations can be performed with very satisfactory results. General experience has shown, however, that it requires a skillful and experienced operator to do a good job of brazing, because considerable dexterity is required to apply the flux and spelter to the joint in a way that will produce workmanship of a satisfactory appearance. Difficulties experienced through lack of uniformity in the strength of brazed joints or a poor appearance of the work have been largely overcome by means of an electric brazing machine which is one of the recent products of the Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York City. This machine consists of two essential parts, namely, an electrical apparatus for generating and localizing heat at the points where the brazed joints are to be made, and provision for clamping the pieces to be brazed so that the surfaces to be joined are held in the proper relation to each other.

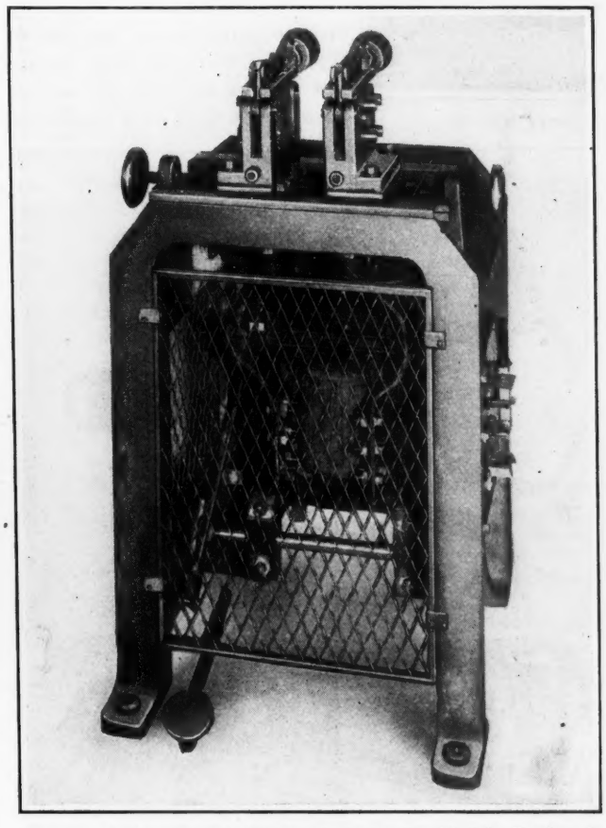


Fig. 1. Electric Brazing Machine built by the Electric Brazing & Welding Machine Co., Inc.

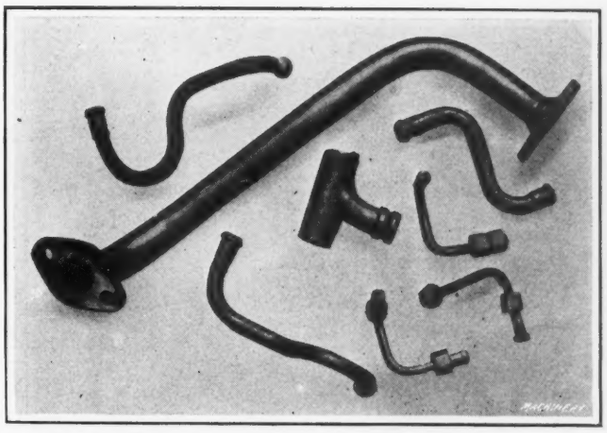


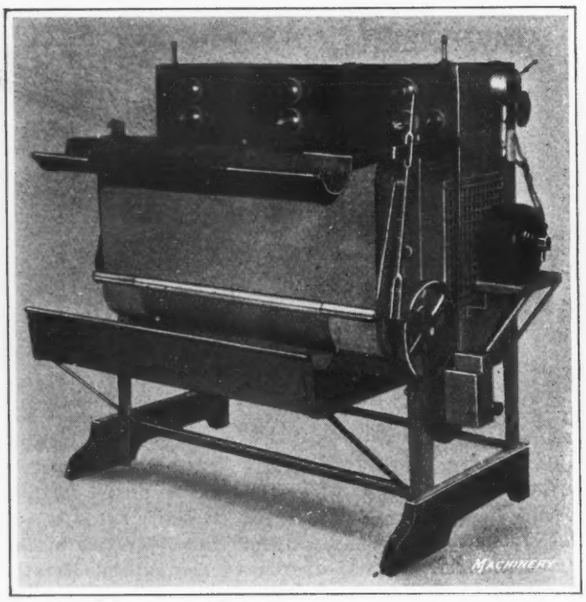
Fig. 2. Examples of Work done by the Electric Brazing Machine shown in Fig 1

The statement has been made that, when operating by the old method of brazing, an experienced and skillful operator was required. With this electrical machine, however, the method of operation is so simple that it has even been possible to have the machines operated by inexperienced girls, with satisfactory results. The method of procedure in making a brazed joint on one of these machines is as follows: A flux is made up in the form of a paste consisting chiefly of borax and water, and the ends of the work to be brazed are dipped into this paste. For the sake of discussion, let it be assumed that two pieces of tubing are to be brazed together at right angles. The spelter used in brazing is made up in the form of wire so that a piece may be cut off which is of sufficient length to wrap around the tube which is supported in a vertical position. The length of this piece of spelter is very carefully adjusted so that just the required amount of metal is furnished to braze the joint. After the operator has dipped the ends of the work in the flux, the ring of spelter will be slipped over the tube which is held in a vertical position, after which the two surfaces to be brazed are put together and clamped on the machine. Then the electric current is applied, which instantaneously heats the work and causes the ring of spelter to melt and run down into the joint, after which the current is shut off and the work allowed to cool sufficiently before it is removed from the machine. It is stated that brazed joints of uniform strength and satisfactory appearance can be made on these machines by operators of practically no previous experience.

WAGENHORST ELECTRIC BLUEPRINTER

J. H. Wagenhorst & Co., of Youngstown, Ohio, are now building a flat-glass continuous electric blueprinting machine, which is made in various sizes and styles to meet the requirements of different drafting-rooms. These include a style G machine which has a capacity for making prints up to 44 inches in width, and which may be furnished for use on 60-cycle alternating current of 110 or 220 volts, or on direct current of 110 or 220 volts; and also a style H machine, having a capacity for making prints up to 56 inches in width, which may be equipped for operation on any of the four different kinds of current referred to for the style G machine. In working out the design, care has been taken to locate the control switches, speed regulator, and feeding and receiving trays so that they are all within easy reach of the operator. Another important point is that by opening the doors, all electrical connections, etc., are accessible.

On this machine, the curtain is a continuous belt made of heavy canvas and mounted on a series of flat ribs. It is held against the flat glass by means of adjustable pressure shoes, and supported by flanged sprocket wheels which assure uniform travel of the curtain. A standard motor

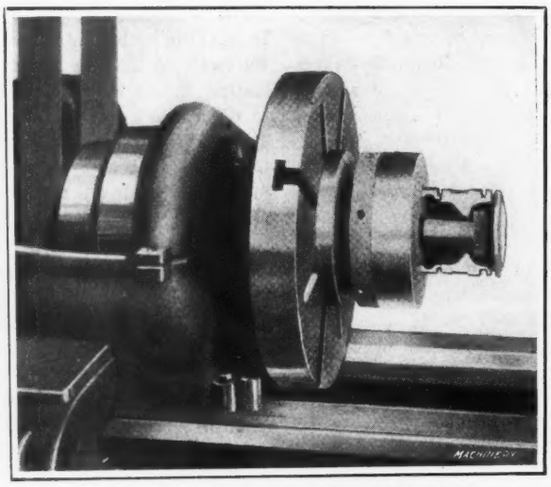


Electric Blueprinting Machine made by J. H. Wagenhorst & Co.

with a fan attachment actuates the curtain and also cools the machine. The speed reduction consists of a worm and wheel belted to the motor, and an oscillating lever connected to the clutch. While standing at the front of the machine, the operator can change the curtain speed from zero to the maximum in less than one second, and this can be accomplished while the machine is in operation. He can also stop or start the curtain instantly while the motor is running. Rolls of blueprint paper and tracings are supported by a trough; and the paper can be cut to any size while the machine is feeding, if so desired, a cutting edge being provided for that purpose. After passing through the machine, the blueprint and tracings are delivered to a receiving tray within easy reach of the operator, which is an especially important feature where it is necessary to make two or more blueprints of the same tracing. There is also an automatic receiving roller provided for use on the machine, which will take up complete rolls of printed paper or any desired part of a roll. The arc lamps, rheostats, and wiring are permanently supported within the cabinet of the machine. Arc control switches regulate the resistance of the rheostats, which regulate the size and intensity of the arcs.

HARTOG PISTON CHUCK

The S. D. Hartog Mfg. Co., St. Louis, Mo., is now making what is known as the "Tell-tale" piston chuck, which is so designed that provision may be made for clamping it to the faceplate of a lathe or for screwing it onto the spindle nose. With a piston held on this chuck, the turning, grooving, or grinding operation can be advantageously performed. The clamping device is so arranged that there is little danger of cracking the piston or of springing it out of shape, regardless of how tightly the nut is set. To operate the chuck, a pin wrench is used, and by turning the nut in the right direction with this wrench, a T-head bolt is tightened or loosened on the inside of the piston. The arrangement will be perfectly clear by referring to the illustration. It will be seen that the clamp engages bosses on the inside of the work and draws it back so that the skirt of the piston comes against the face of the chuck. To place a piston on one of these chucks, the T-head bolt is entered through the opening between the bosses, after which the bolt is turned through 90 degrees so that the T-head comes over the tops of the bosses ready to have the nut tightened.

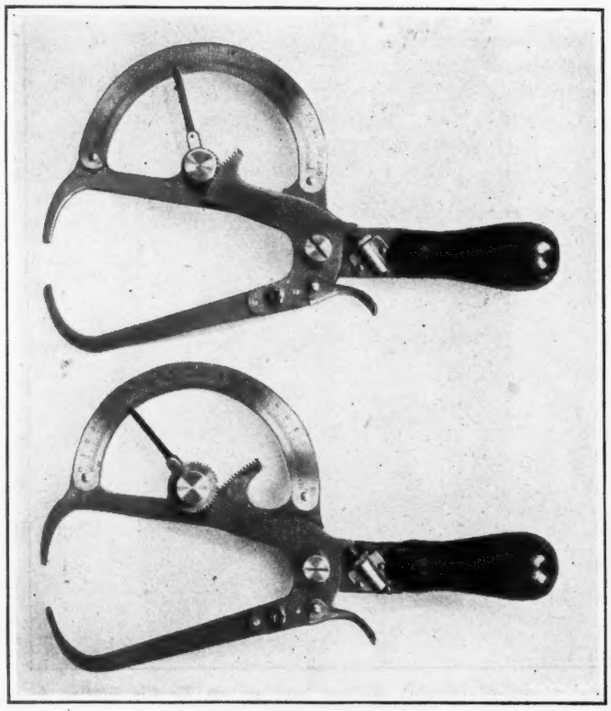


Piston Chuck made by S. D. Hartog Mfg. Co.

INDICATING CALIPERS

In the accompanying illustration are shown two types of indicating calipers which have recently been placed on the market by the Indicating Calipers Co., 506 E. 19th St., New York City. It is claimed that these tools combine the advantages of an ordinary caliper, a scale, and a magnifying glass; in other words, they increase the accuracy of measurements, which can be made without requiring the use of a magnifying glass for setting. The calipers shown in the illustration have the jaws open ¾ inch, and by reference to the graduated scales it will be seen that one reads from 0 to 200, each graduation corresponding to 0.010 inch, so that the instrument has a capacity for measuring work up to 2 inches in diameter. The other caliper has a scale graduated from 0 to 3 inches, with graduations which indicate 1/64, 1/32, 1/16, and 1/8 inch, etc.

It will be seen in the illustration that there is a curved trigger which the mechanic uses in manipulating the calipers. By pulling this trigger back, the jaws are opened and the indicating needle moves over the scale. Then when the jaws have been set in place and the trigger released, this needle comes back to rest over the graduation which indicates the spread of the jaws, and consequently the size of the work that is being measured. After the trigger which opens the jaws has been released, a coiled spring causes the jaws to close on the work. The points of the jaws are hardened, so that wear is reduced to a minimum.



Calipers with Two Styles of Graduated Scales made by the Indicating Calipers Co.

KENT BAR STOCK RACKS

In the illustrations which accompany the following description there are shown two forms of bar stock racks which have recently been developed and placed on the market by the Kent Machine Co., Kent, Ohio. It will be apparent that the rack shown in Fig. 1 is designed to provide a convenient means of storing bars of considerable length, and that the rack shown in Fig. 2 is especially adapted for carrying pieces of relatively short length.

The bar stock rack arms for long stock, Fig. 1, are made in single sectional units, which may be spaced any distance apart to accommodate the length of stock to be held. Each of these units is made up of a number of interlocking sections so that any number of arms and any height of unit may be obtained. The base of the unit projects out beyond the longest arm, thereby giving each unit stability and keeping the center of gravity of the load within the area of footing. As will be seen from Fig. 1, the base is provided with a projection in order that it may be used as an arm for holding stock. The weight of this stock also adds to the stability of the unit. Adjustment of the arms may be varied by using the interlocking spacing collar, and large spaces may be obtained for light yet bulky material, such as tubing, etc. All arms and spacing collars interlock with the base, and no set-screws or holding devices are required in the assembly. The hole in the sectional pieces of the arms is bored to fit the vertical spindle and the interlocking devices are fitted so that there is practically no lost motion. With the combination of adjustable spacers, these racks may be adapted for storing material of various sizes, and enough arms may be placed on the vertical spindle to provide for a proper classification of the material stored.

Fig. 2 shows a three-arm sectional interlocking unit, complete in itself, for the storage of short lengths of stock. The presence of a piece of short length in the long bar rack is always annoying, causing considerable difficulty in removing the longer lengths of stock. To avoid this difficulty the short-length rack arm has been designed to be used in connection with the longer units. Spacing of the arms on this device, as well as on the rack shown in Fig. 1, may be varied by the use of interlocking spacing collars, so that any type or size of material is well provided for. The racks are constructed of cast iron. The arms have been thoroughly tested to carry all the material that can be stored on them.

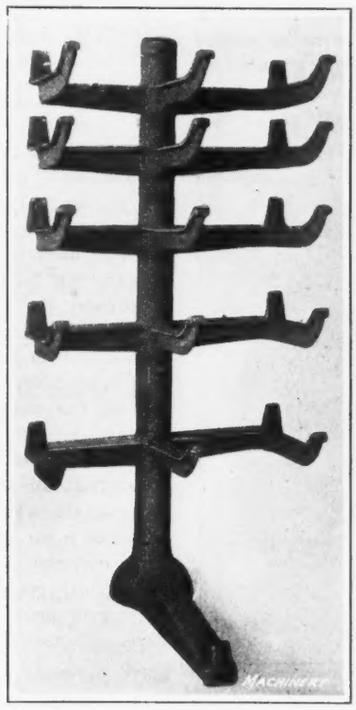


Fig. 2. Stock Rack built by Kent Machine Co. for storing Short Pieces

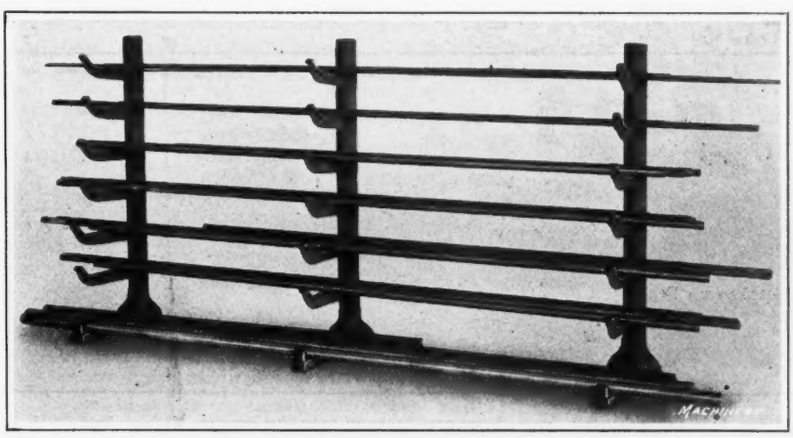
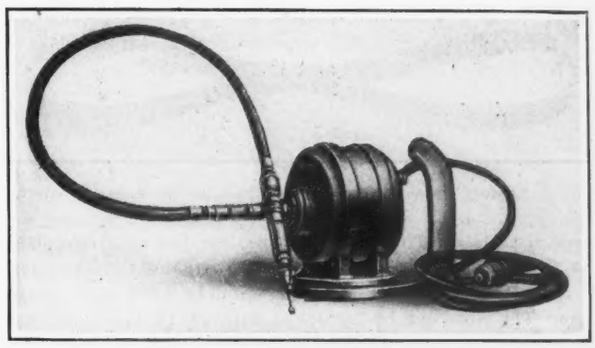


Fig. 1. Rack built by the Kent Machine Co. for Use in storing Long Bar Stock



Portable Motor-driven Die-sinking Machine made by the Modern Mfg. Co.

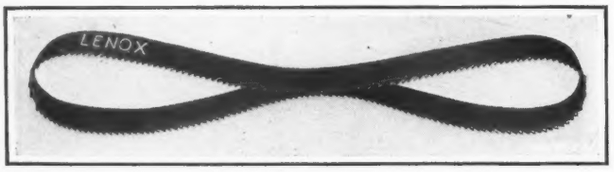
MODERN DIE-SINKING MACHINE

The Modern Mfg. Co., 75 Third St., Bridgeport, Conn., has recently placed on the market a portable motor-driven die-sinking outfit, consisting of a motor which can be placed on a bench or suspended in a vertical or horizontal position. The motor is provided with a cord for making connections to an electric circuit, and a flexible shaft by means of which power is transmitted to the tool. This machine is adapted for use in sinking drop-forging or embossing dies, and enables such work to be done with considerable rapidity. A comparison has been made between the work of a die-sinker using one of these tools and that of a dentist who is preparing a cavity for filling. This parallel is fairly accurate, except that in the case of the die the opening is, of course, infinitely larger. The cutting tools used for both classes of work are somewhat similar. It will be seen that there is what is known as a "hand piece" at the end of the flexible shaft, and its design is worked out in such a way that cutting tools or abrasive points may be mounted or removed without stopping the motor.

This die-sinking outfit is made in two sizes, known as Nos. 1 and 2, which have capacities for taking tools with shanks up to 3/16 and 1/16 inch in diameter, respectively. The standard motor that is provided with this equipment is adapted for use with a 110-volt alternating current, but other motors can be furnished to order. For use in connection with this die-sinking equipment, various types of chucks and abrasive wheels and disks may be provided, and also a variety of different high-speed steel burrs and abrasive points. This range of tools enables the operator to work out the details of dies where there are a number of small openings and fine details of design that would ordinarily have to be cut by hand.

"LENOX" METAL-CUTTING BAND SAW

The "Lenox" metal-cutting band saws here illustrated and described are a recent product of the American Saw & Mfg. Co., Springfield, Mass. These saws may either be cut to the desired length and have the ends brazed together ready for use, or they can be furnished in coils of any specified length. Six different sizes are made in widths of ¼, ⅜, ½, ⅝, ¾, and 1 inch. The thickness of the first

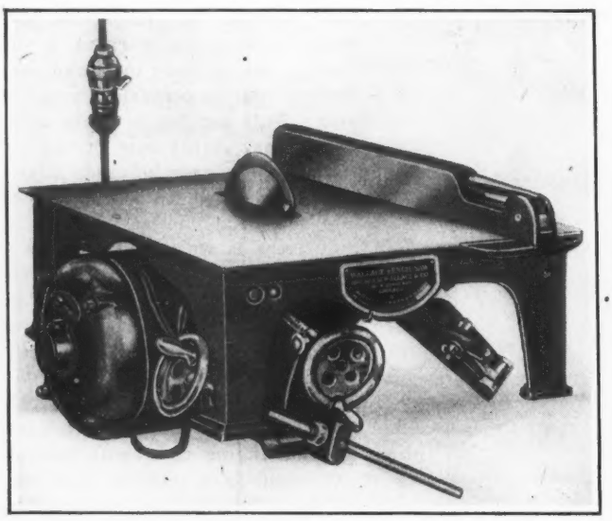


"Lenox" Metal-cutting Band Saw made by the American Saw & Mfg. Co.

three sizes is 0.025 inch, or 23 gage; for the next two sizes, the thickness is 0.032 inch, or 21 gage; and the thickness of the sixth, that is, the 1 inch size, is 0.036 inch, or 20 gage. The saws can be furnished with 10, 14, 18, or 24 teeth per inch, and they may be tempered to meet all metal-cutting requirements.

WALLACE BENCH SAWING MACHINE

In the accompanying illustration is shown a bench circular sawing machine which is a recent product of J. D. Wallace & Co., 1401 W. Jackson Blvd., Chicago, Ill. It is adapted for use in pattern shops and other woodworking establishments; and through enabling sawing operations to be performed at the bench, time is saved which would otherwise be wasted in going back and forth between the bench and a floor type machine. This saw is equipped with individual motor drive, and is designed to operate from an electric lighting circuit.



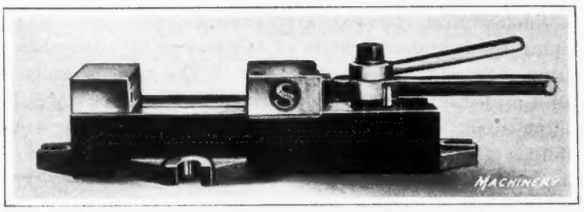
Circular Sawing Machine built by J. D. Wallace & Co. for Use in Woodworking Shops

Ample power is provided to enable it to take a full 2-inch cut through hard wood, so that the saw can be used for practically all classes of work that are generally done by hand or on a large circular sawing machine.

Several new features have been developed in working out the design. To provide for cutting at an angle, the saw is tilted, instead of adopting the practice of tilting the table. The advantage claimed for this feature is that it obviates trouble sometimes experienced through having long pieces of work which are being cut on an angle come into contact with the floor. Accurate settings may be made to cut at any desired angle by simply turning the handwheel until an indicator on a graduated dial shows that the required setting has been obtained. The setting is accomplished by means of a handwheel, which actuates a screw and swiveled nut that swings the cradle on which the motor-driving mechanism and saw are mounted. When the desired setting has been obtained, the screw holds this cradle firmly in place. Provision is made for raising or lowering the saw to cut or groove stock any depth to 2 inches. The raising and lowering mechanism is similar to the tilting mechanism and is controlled by a handwheel. The machine is driven by a ½-horsepower General Electric motor.

SPAFFORD QUICK-ACTING VISE

The Spafford Tool Works, 10 Hoadley Place, Hartford, Conn., have recently placed on the market what is known as the "Supreme" quick-acting vise, which is adapted for general shop use or for use on hand or power milling machines, grinding machines, etc., that are engaged on quantity production work. The vises are made in four different sizes,



"Supreme" Quick-acting Vise made by the Spafford Tool Works

having openings of 3, 4, 5, and 7 inches, respectively. All steel parts are made from either drop-forgings or bar stock, hardened and ground, and the base of the vise is carefully scraped to fit the slide. In order to allow the loose jaw to be transferred from one vise to another, these jaws are drilled to gages, which assures interchangeability. Semi-steel is used in making the base of the vise, and the stationary jaw is let into a recess which affords ample support to prevent the alignment of the jaw from changing. Quick action of the movable jaw of this vise is secured by means of a cam-lever which draws it tightly against the work, after which an eccentric lever is finally tightened to secure this jaw on the work. The hardened slide is smooth on its top surface, and the levers are firmly held in place by means of a bolt fitted into a T-slot, the under side of which is located at an angle, and the bolt head is finished to the same angle, which produces a wedging action and makes it impossible for the bolt to slip back. A pin against which the cam-lever works in opening the vise is so located that when fully opened the lever slips past the pin and avoids danger of breaking the pin or elongating the hole in the base.

MONARCH ENGINE LATHES

A 24-inch quick-change-gear engine lathe equipped with a three-step cone pulley and double back-gears, and a 12-inch lathe with a four-step cone pulley and single back-gears are recent products of the Monarch Machine Tool Co., Sidney, Ohio. On the 24-inch lathe, the apron is of the double plate type, and frictions are used for operating both longitudinal and cross feeds. All apron gears are made of drop-forged

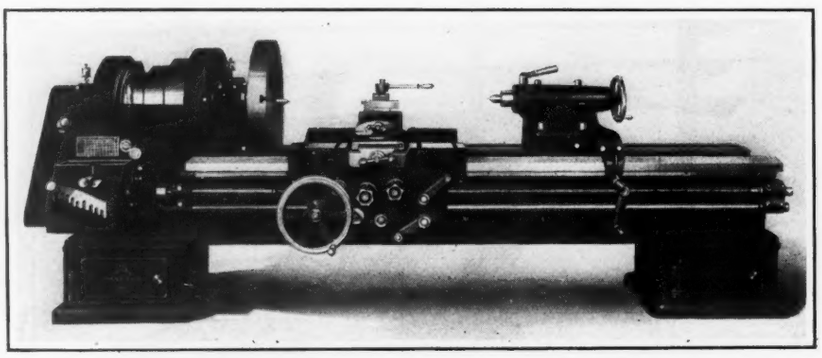


Fig. 1. Twenty-four-inch Quick-change-gear Lathe built by the Monarch Machine Tool Co.

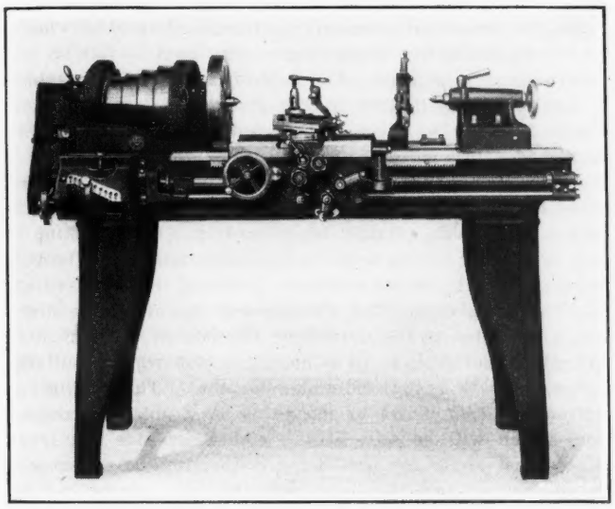


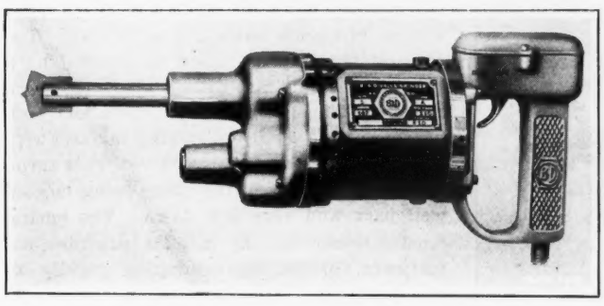
Fig. 2. Twelve-inch Quick-change-gear Lathe which is a Recent Product of the Monarch Machine Tool Co.

steel. These lathes are heavily constructed to meet the requirements of severe service, and are equipped with a countershaft in which the hangers and clutch pulley run on Hyatt roller bearings. This lathe is driven from the countershaft by a belt 6 inches in width.

The 12-inch lathe illustrated in Fig. 2 has been designed with a view to producing a universal small lathe—one which could meet the demand of precision work, and still be built in large quantities. It is provided with a lead-screw reverse in the headstock, and the rack pinion is disengaged when the machine is used for thread cutting. All gears in the quick-change box are made of steel and bronze-bushed. Provision is made for cutting from 3 to 96 threads per inch. The machine shown has a four-step cone pulley and single back-gears, and carries a belt 2 inches in width. This lathe is also built with a three-step cone pulley and double back-gears.

BLACK & DECKER VALVE GRINDER

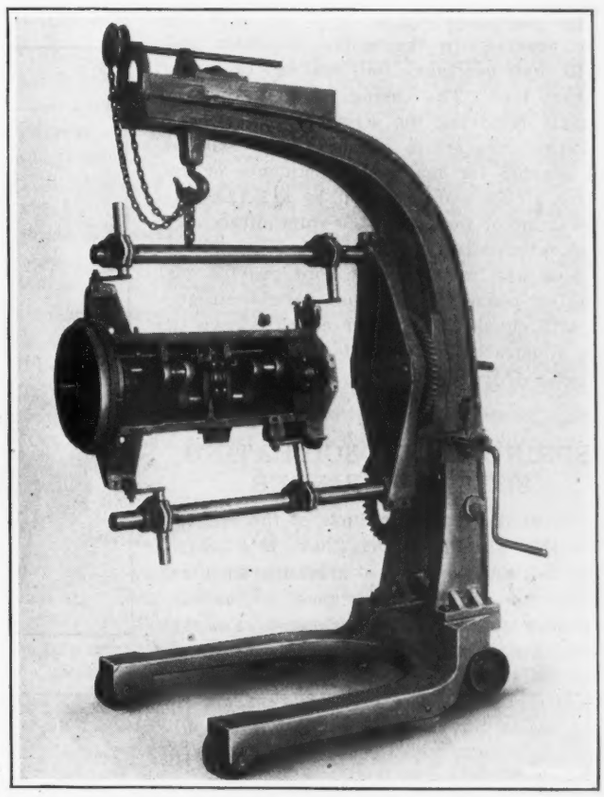
The Black & Decker Mfg. Co., 10 Guilford Ave., Baltimore, Md., is now making a portable electrically driven valve grinder which forms the subject of the following description. This device is provided with an oscillating spindle and is used for grinding valves mechanically. The spindle oscillates with a long, steady sweep similar to the movement obtained in grinding by hand. It will be apparent from the illustration that use has been made of the pistol grip and trigger switch features which are used on other tools of this company's manufacture. A 1/6-horsepower motor is provided for driving the tool, which is air-cooled and operates on standard electric power circuits, either alternating current from 25 to 60 cycles, or direct current of 110 or 220 volts. The motor, gearing, and reciprocating mechanism are completely enclosed in an aluminum housing, the gearing and reciprocating device being separated from the motor compartment and packed in grease. Ball bearings carry the grinding spindle, and the armature shaft runs in Norma ball bearings. The gear shafts are ground to size and supported at both ends by phosphor-bronze bearings. Bits may be provided to adapt this tool for grinding various types of valves.



Electrically Driven Portable Valve Grinder made by the Black & Decker Mfg. Co.

CANTON AUTOMOBILE ENGINE FLOOR CRANE

The illustration presented in connection with the following description shows a portable floor crane and hoist built by the Canton Foundry & Machine Co., Canton, Ohio, which is equipped with a special type of motor stand to provide for the rapid handling of automobile engines. This outfit comprises the equivalent of a crane, hoist, truck and workbench for handling motors, and the advantage claimed for the apparatus is that an engine can be taken out of the chassis, hooked onto the motor stand, and taken to any part of the shop—for instance, to a window where the light is good. Provision made for revolving the engine enables the mechanic to reach any part of its mechanism. If work is to be done on the crankcase bearings, the engine can be turned around to a position where that part of the mechanism can be easily reached. Then, if it is desired to work

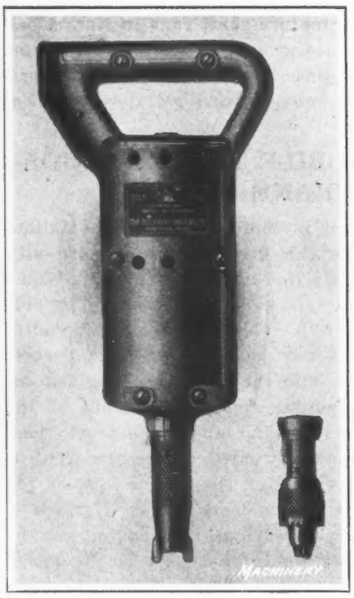


Portable Floor Crane and Hoist built by the Canton Foundry & Machine Co. with Special Attachment for handling Automobile Engines

on the cylinders, the engine may again be turned over so that the workman gains ready access to the desired point. Portable cranes equipped in this way are adapted for use in garages or in automobile manufacturing plants. They have a capacity for loads up to 2 tons, and a lift of 6 feet 4 inches.

PETTERSON DRILL AND VALVE GRINDER

A combination drill and valve grinder is now being made by the Petterson Engineering & Mfg. Co., 311 Main St., Worcester, Mass. This tool is electrically driven and has a capacity for drilling holes up to ¼ inch in diameter. It is stated that less than a minute is required to change the tool from a drill to a valve grinder, or vice versa, and a screwdriver is the only tool required to make the change. When equipped for valve grinding, the tool furnishes the familiar



Petterson Combination Drill and Valve Grinder

oscillating motion used in the performance of this operation. In addition to the combination tool, separate tools are made which provide for the performance of either of the operations which may be handled by the combination outfit.

There are no outside projections which would prevent the tool from working in close corners. A button switch is located in the handle, where it is always within reach to provide for starting or stopping the spindle. The gear-case is packed with grease, and oil-holes are provided in the motor, oscillator and drill shaft bearings. Ball bearings carry the thrust load. The casing is split, and by simply removing the screws which hold it together, the entire mechanism is exposed to provide for making adjustments or repairs. This tool is driven by a 1/12-horsepower motor for 110 to 130 volts, direct current, alternating current, or universal, and a plug and an eight-foot cord provide for making connection to the electric circuit. A drill chuck and grinder chuck, shown in the illustration, provide for holding either a twist drill or a valve grinder, as desired.

SPRINGFIELD OSCILLATING SURFACE GRINDER

One of the recent products of the Springfield Mfg. Co., Bridgeport, Conn., is a heavy-duty oscillating surface grinding machine which was primarily designed for use in grinding steel lithographing plates. For the performance of this particular operation, the machine was equipped to grind with a sandstone wheel instead of one of the commonly used forms of abrasive wheels, as the sandstone was found to give very good service on this particular class of work. The field of this grinding machine is by no means limited to the grinding of lithographing plates, however, as there is no reason why it could not be furnished with a suitable abrasive wheel where the nature of the work demands it. The grinding wheel used on the machine may be of any size up to 36 inches in diameter by 10 inches face width. It will be noticed that this machine is heavily built, the drive to the table being transmitted through bevel gears and a screw reversing device of the form ordinarily used on planers. The wheel-spindle is carried by slides which are fitted to the saddles on the face of the uprights; and when the machine is in operation, the wheel oscillates across the work as it is fed under the wheel. This oscillating motion is accomplished by means of the crank and connection, which will be seen at the right-hand side. A lever located just above the oscillating connecting-rod operates a clutch that engages the bevel gear, and this clutch can be engaged or disengaged at will, so that the wheel will travel in a straight path instead of oscillating, when the final finishing grinding is being accomplished. This machine has a capacity for grinding work up to 26 inches wide by 60 inches long, and it weighs about 13,000 pounds.

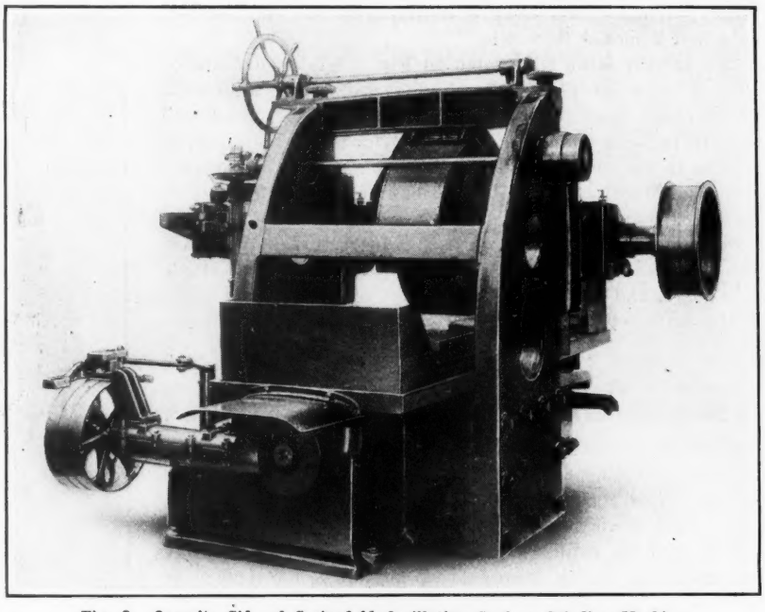


Fig. 2. Opposite Side of Springfield Oscillating Surface Grinding Machine

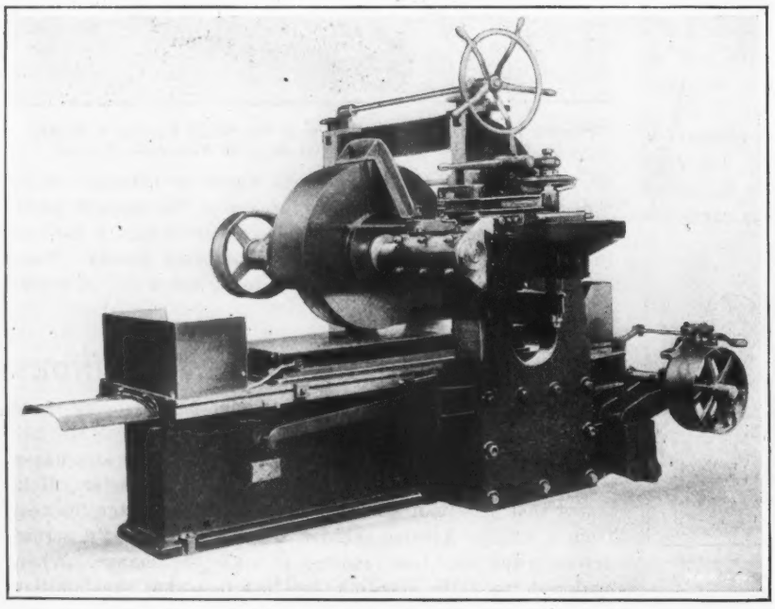
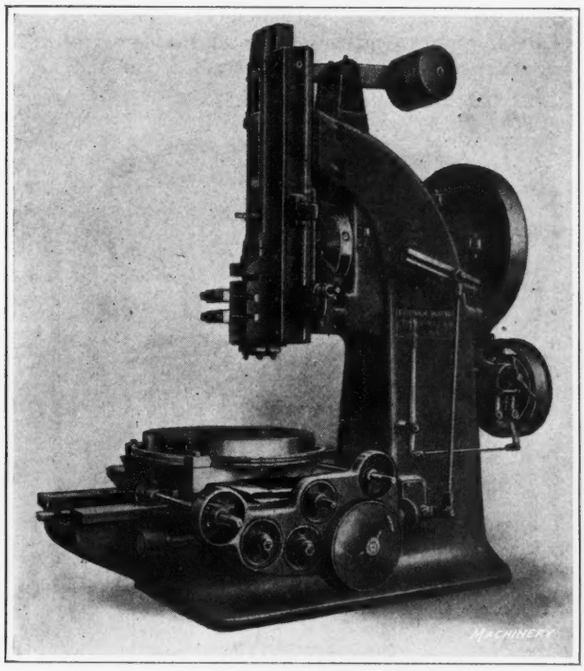


Fig. 1. Oscillating Surface Grinding Machine built by the Springfield Mfg. Co.

PUTNAM SLOTTING MACHINE

The Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass., are now building 15- and 18-inch slotting machines of the type here illustrated. In working out the design, care has been taken to locate all levers, etc., within convenient reach of the operator. The weight mounted on the forged steel arm affords a counterbalance for the cutter-bar, which is equipped with a McCord's quick-return motion. The cutter-guide may be raised or lowered by a screw to a point immediately above the work being machined. The relief apron has both horizontal and vertical clamping surfaces with hardened and serrated steel faces. This apron is hinged to the ram, the hinge being located well back and very low down. The spring tension controlled by a pilot provides adjustment, or permits clamping rigidly to the cutter-bar. Incorporated in the crank-disk construction, there is a stroke indicator which shows at all times the length of stroke for which the machine is set.

Surrounding the circular table, there is a trough to catch the cutting lubricant, and this table is graduated all around the circle, which facilitates setting it in any desired position. Locking is accomplished by four clamps. The compound table is supported for its entire width on the carriage. Power feeds and hand adjustments are provided for the table in all directions, that is, cross, longitudinal, and rotary, all of which are controlled from the operating side of the machine and so arranged that only one feed can be engaged at a time. These feeds are actuated by a cam on the crank disk shaft and a wide range of positive feeds is provided. All feed movements are engaged when the ram is at the upper end of its stroke. The rocker arm supporting the feed pawl is held on the shaft by a friction clamp, allowing it to slip in the event of the table encountering an obstruction, thus preventing damage to the mechanism.

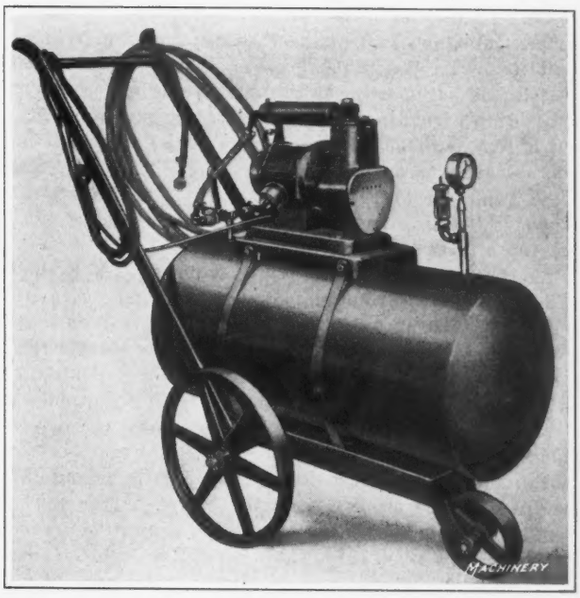


Slotting Machine built in 15- and 18-inch Sizes by the Putnam Machine Works of Manning, Maxwell & Moore

Eight cutter-bar speeds are provided by means of a four-speed gear-box and a two-speed countershaft with a single pulley belt drive to the machine. The pulley is mounted on a powerful friction clutch operated by a conveniently located lever, and throwing out the clutch also applies a brake which quickly stops the machine. A four-speed selective sliding gear transmission is used, allowing the gears to be shifted instantly to the desired position. All gears are made of heat-treated alloy steel, and both the gears and shafts are served by a splash system of lubrication. By using the interlocking gear shift lever, assurance is obtained that the main friction will be released and the shaft slowed down before the gears can be shifted. Simplicity is the chief claim made for the McCord quick-return mechanism. It consists of a link connecting the main driving gear to a crank keyed to the cutter-bar operating shaft. This link has holes bushed with bronze and it turns on steel pins, and the parts are so proportioned that the cutter-bar speed is nearly uniform on the working stroke, with a 2 to 1 ratio between the return and the working stroke. The regular equipment furnished with this machine includes a two-speed countershaft and the necessary wrenches for making all adjustments.

BLACK & DECKER "LECTROFLATER" OUTFIT

The Black & Decker Mfg. Co., 10 Guilford Ave., Baltimore, Md., is now building a "lectroflater" outfit comprising a ½-horsepower electrically driven air compressor with a capacity

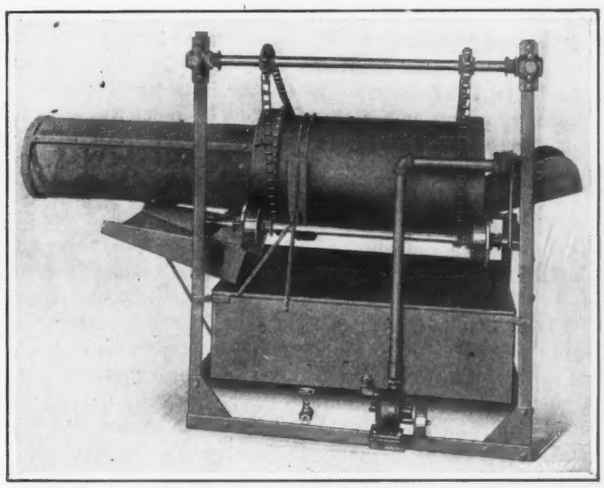


Portable "Lectroflater" Outfit built by the Black & Decker Mfg. Co.

of two cubic feet of free air per minute, and a cylindrical pressed steel receiver 14 by 30 inches in size mounted on three wheels and provided with a handle so that the entire apparatus can be easily transported from one part of the plant to another. This outfit is completely equipped with a switch, electric cable, attachment plug, pressure gage, safety valve, 25 feet of hose, and all necessary piping and wiring. The air compressor is the standard Black & Decker No. 2 equipment, and the electric motor develops a full ½-horsepower and may be used on either alternating current up to 60 cycles, or on direct current. A compact form of construction is obtained by enclosing the motor, gear train and compressor in a single housing. The motor and compressor are cooled by forced circulation of air through this housing, and they can run continuously without overheating. The motor, gears and compressor, including the cylinder walls and piston, are lubricated with grease by capillary action.

METAL CLEANING MACHINE

For use in removing grease from the product of automatic screw machines and other work of like nature, the Ideal Concrete Machinery Co., Cincinnati, Ohio, is building a metal cleaning machine which is here illustrated and described. It consists of a barrel, or drum, mounted above a heating tank for the cleaning solution. Within this drum there is a worm attached to the drum shaft, and at one end a gap for discharging the work from the drum onto a drying



Metal Products Cleaning Machine built by the Ideal Concrete Machinery Co.

screen. From the heating tank the cleaning solution is pumped into the drum at the charging end, and from that point it flows through the drum and drains back through holes in the periphery near the discharging end. The solution is drawn from the bottom of the tank, and as the grease that is removed from the work floats to the top of the solution, assurance is obtained of the delivery of clean solution to the drum. In operating the machine, a practice is made of always keeping the drum in which the work is cleaned partially filled with the solution.

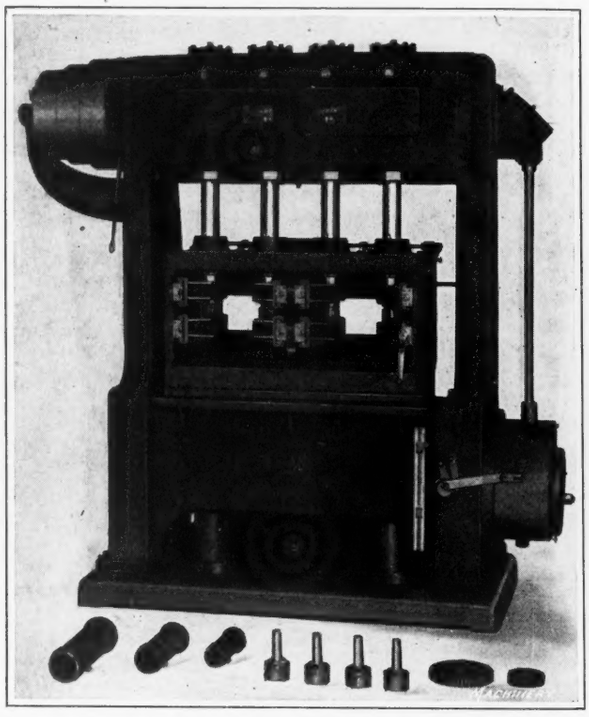
From the charging end of the machine, the work is impelled through the rotation of the drum and worm, thus carrying it through to the discharging end, and then onto the draining screen from which the work is transferred to tote boxes or any other convenient receptacle. At all times, the work lies at the bottom of the drum, and is submerged in the cleaning solution during its passage through the drum. At the time it passes out onto the drying screen it is clean and carries sufficient heat to facilitate drying. This machine is in no sense a tumbling barrel, as the work is never lifted from the bottom of the drum and the speed of rotation is only seven revolutions per minute, which is slow enough to permit threaded work being cleaned without marring the threads. Machines of this type are manufactured with capacity for cleaning from 5000 to 60,000 pounds of metal products per day. In some cases, it is desirable to rinse the work as well as wash it, and in such cases the machines are placed in a series, with cleaning solution running through one machine and clean water through the other.

DEFIANCE CYLINDER BORING MACHINES

The vertical cylinder boring machine shown in the accompanying illustration is built in Nos. 7, 8, and 9 sizes by the Defiance Machine Works, Defiance, Ohio. These are single-purpose production machines designed to meet the requirements of gas-engine manufacturers for roughing, semi-finishing, and finish-boring gas-engine cylinders of either single units or any number of units cast en bloc. After the work-holding fixture and tools have been set on this machine, the operator is only required to load and unload the fixtures, as the remainder of the operation is automatically controlled. Application of combination forced feed and the splash system of lubrication is made possible by the completely enclosed form of construction which has been adopted. Both the feed and driving mechanisms are encased and partially submerged in a bath of oil, while the bearings are lubricated by forced feed through individual leads. Unit construction has been adopted for various parts of the mechanism, and each unit is readily accessible without disturbing other parts of the mechanism.

Power is transmitted to the spindle from a three-step cone pulley through steel worms and bronze worm-wheels, with connection made from the worm-wheel to the spindle by a tongue which is an integral part of the spindle. The spindles are driven at a point close to the nose, which reduces the possibility of torque, chatter and other undesirable conditions of operation. Each spindle is supported by three bronze bearings with the nose bearing made conical in shape and provided with convenient means of adjustment for taking up wear. All thrust is received by two sets of SKF ball bearings between which each spindle moves. After the power has been shut off, the rotation of the spindles can be instantly stopped by means of a friction brake located in the driving pulley, this brake being manipulated by means of a lever that is conveniently located for the operator. The boring tool is fitted to the spindle by a tapered shank and is held in place by a lock bolt leading through the spindle through the top, which eliminates any possibility of its being pulled out from the spindle on the return stroke.

The feed unit is completely enclosed in a case which retains oil at a level sufficiently high to take advantage of the splash system of lubrication. All feed shaft bearings are bronze bushed and end thrusts are carried by SKF ball bearings. Changes of feed are accomplished by removing the gear-case cover and changing two gears. Hand adjustment is provided for the table, but when the machine is in operation the table automatically feeds the work to the boring tools, and after the cut has been completed, it automatically reverses to a fast traverse and returns to the lower position, where it stops. The raising or lowering of the table is accomplished by means of jack-screws which are self-contained units with their contents packed in grease. Means of tightening or loosening the screws independently of each other is provided in order to maintain perfect alignment of the table. As in other parts of the mechanism where thrust loads have to be carried, SKF ball bearings are employed for taking the thrust of the jacks. The table, columns and base of the machine constitute the frame, and they are cast from a close-grained gray iron. The table is gibbed to the columns at each side in order to provide means of maintaining an accurate feed on the sliding surfaces. The columns and base are of a box construction and heavily



Four-spindle Cylinder Boring Machine built by the Defiance Machine Works

reinforced, and the base rests on the floor at three points only, which eliminates the necessity of building a special concrete foundation. The capacity of the No. 7 machine is 36 inches between the housings, of the No. 8 machine 48 inches between the housings, and of the No. 9 machine 60 inches between the housings. Special attachments, such as work-holding fixtures, boring tools, pump tank and pipe for the distribution of cutting lubricant, or an individual motor drive, may be provided as special features.

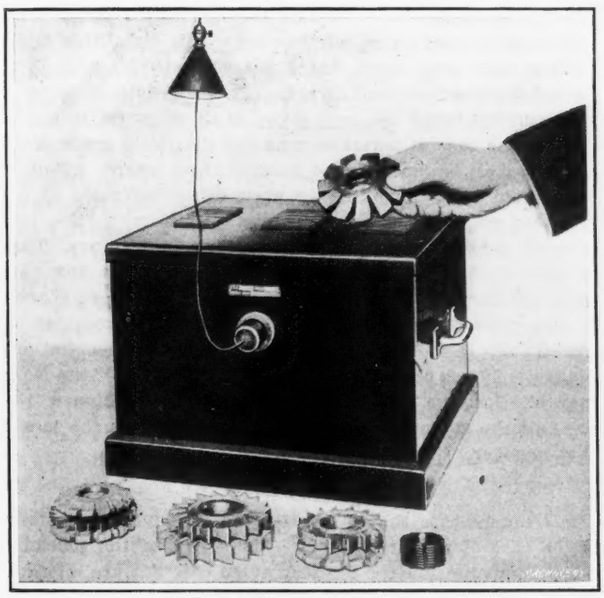
ELECTRIC DEMAGNETIZING MACHINE

Some shops experience a considerable amount of trouble through having milling cutters, micrometers, and other tools accumulate a sufficient amount of magnetism so that chips of iron and steel are caused to cling to them. There are several reasons for this tendency of tools to become magnetized, among which the more common are the accumulation of residual magnetism in parts that are held on magnetic chucks, or the accumulation of magnetism as the result of static discharges from belts, etc.

Inside the box of the demagnetizer there is a coil of wire wound around the middle pole, through which alternating

electric current flows. This develops magnetic lines of force across the three poles of the demagnetizer, which cut the magnetic flux and effect the demagnetization of the tool or other piece of magnetized iron or steel that is drawn across the poles of the instrument.

The "Bull Dog" tool demagnetizer which has recently been placed on the market by the Electric Brazing & Welding Machine Co., Inc., 30 Church St., New York City, is an electrically operated device which is so designed that it may be connected to an alternating-current lighting circuit of 110 or 220 volts, and of any standard frequency. All that is necessary is to connect the demagnetizer with the lighting circuit by means of the familiar form of lamp cord, and the instrument is ready for use. At the top of the case there are three poles, each of which is approximately two inches in width, with a spacing of two inches from center to center of the poles. To demagnetize a tool, it is merely necessary to draw it across the faces of these poles. If the tool is large enough, it is allowed to touch all three of the poles, or, if the tool is small, it is allowed to touch two poles, or even one pole. The action of the demagnetizer is



Electric Demagnetizer made by the Electric Brazing & Welding Machine Co., Inc.

said to be instantaneous, it being merely necessary to draw the tool across the face of the poles and all magnetism will be completely removed.

In some plants, very satisfactory results are being obtained by placing one of these demagnetizers beneath the counter at the tool crib window, with the poles projecting up to the top level of the counter. Then, as the tools come in from the shop, they may be drawn across this demagnetizing instrument, thus giving assurance that, when again placed in service, no trouble will be experienced through the tendency of magnetic force to cause chips to stick to the tools.

NEW MACHINERY AND TOOLS NOTES

Plate Rolling Mill: Morgan Engineering Co., Alliance, Ohio. A plate rolling mill which is said to be the largest equipment of its type ever built in America. The mill has a capacity of 180 inches and is intended for export to Japan, at the plant of the Imperial Steel Works in Tokio.

Scarfing Machine: Hilles & Jones Co., Wilmington, Del. A ship plate scarfing machine which is equipped with a draw-knife shaper action to provide for simultaneously scarfing both corners of a plate. Machines of this type are built in different lengths to provide for the performance of scarfing operations on plates with considerable variation in size.

Roller Bearing: George D. Bailey Co., Chicago, Ill. A roller bearing which is equipped with concave rollers that run in convex raceways. The rollers and raceways are also tapered, the design being worked out in such a way that the bearing has capacity for carrying a thrust load and provision for taking up lost motion, in addition to supporting the usual radial loads that come on a journal bearing.

Master Controller: Cutler-Hammer Mfg. Co., Milwaukee, Wis. A multi-speed master controller for use in connection with automatic magnetically governed controller. It is especially applicable for employment in connection with steel-mill and crane controllers where the operator's attention should not be diverted from the work or machine, and for use in positions where the amount of available space is limited.

Punching, Trimming, and Shearing Machine: Long & Allstatter Co., Hamilton, Ohio. A combination multiple punching, trimming, and shearing machine which provides for the performance of a cycle of operations on a plate or structural shape at a single setting of the work. All of the tools used on the machine are clamped in position by T-head bolts which are located in accessible positions, so that the tool setter's work is facilitated as far as is possible.

Planing Machine Jacks: Kent Machine Co., Kent, Ohio. A line of jacks which are made in three sizes covering a range of from 2 to 6 inches. The bases of these jacks are made of cast iron with adjustment secured by means of a screw placed in the top of the casting. A set-screw prevents the adjusting screw from turning while the jack is in use, the set-screw engaging a brass plug, which, in turn, bears on the adjusting screw so that mutilation of the thread is avoided.

Roll Lathe: Standard Engineering Co., Ellwood City, Pa. A machine which is claimed to be the largest roll-turning lathe ever built in this country. It is for shipment to a steel plant in Japan. The machine swings 62 inches over the necking rests and has a total weight of approximately 275,000 pounds. The bed is 42 feet in length, and owing to difficulty which would otherwise have been experienced in transportation, it is made in three sections, each of which is 14 feet long.

Keyseat Milling Machine: Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. A horizontal keyseat milling machine which is built along lines to adapt it for heavy duty. This machine is especially suitable for milling keyseats in long shafts, owing to the table being supported for its full length to avoid overhang. Another advantage of this type of machine is that provision is made for milling keyseats in multiple, thus saving time and reducing production costs.

Gear-hobbing Machine: Jones Superior Machine Co., Chicago, Ill. A powerful gear-hobbing machine designated as No. 48, which is adapted for generating the teeth of gears up to 72 inches in diameter by 20 inches face width, the minimum diameter of work which can be handled being approximately 10 inches. To make it possible to handle such small work, the column has been under-cut in such a way that the table can be fed inward until it swings beneath the ways on which the hob saddle is mounted.

Drill Chuck: Montgomery & Co., Inc., New York City. A chuck adapted for use in holding straight-shank drills. This chuck is claimed to be capable of releasing the drill instantly without the use of a wrench or any other tool to manipulate the chuck. There are no projections which could catch and injure the operator's hands or clothing. The chuck jaws are made of chrome-nickel steel and are claimed to be strong enough to stand any reasonable strain to which a drill chuck will be subjected while in service.

Soldering Iron: Cutler-Hammer Mfg. Co., Milwaukee, Wis. A soldering iron especially adapted for use in making tin cans used for packing various food products. This iron consists of a pair of heating units insulated by mica and covered with a steel jacket pressed into close contact with the mica. The heating units are located at both sides of a piece of bar copper and gripped between two iron plates, forming a clamp. The iron is rated at 200 to 225 watts and is said to have a remarkably high degree of heating efficiency.

Piston Chuck: S. D. Hartog Mfg. Co., St. Louis, Mo. This chuck is adapted for use in garages, service stations, and other shops in which it is sometimes necessary to re-turn piston ring grooves in pistons for gas engines or automobile motors. The design is worked out in such a way that the piston may be re-turned without the necessity of removing the connecting-rod. The skirt of the piston is pulled up against the face of the chuck and held in place by sliding a pin through the crankshaft bearing in the connecting-rod.

"Mult-au-matic": Bullard Machine Tool Co., Bridgeport, Conn. Readers of MACHINERY are familiar with the features of the 14-inch "Mult-au-matic" built by this company. Recently an 8-inch machine has been added to the Bullard line. This smaller sized machine follows the same general lines

of construction which have been successfully employed in the larger tool. The claim is made for the new machine that it is equivalent to six automatically operated engine lathes working in sequence and operated by one man, whose duties consist of loading and unloading pieces from the work-holding fixtures. As both the machine and the operator are kept constantly employed, idle time is reduced and a high rate of production is attained.

Portable Electric Grinding Machine: Saphil Mfg. Corporation, 149 W. Austin Ave., Chicago, Ill. A portable tool, cutter, and surface grinding machine which is equipped with individual electric motor drive. This machine, or more properly attachment, is designed to be placed over the toolpost on a lathe, and is held in place by means of the regular toolpost screw. The grinding spindle may be raised or lowered to the desired position by means of a micrometer adjustment, and the drive from the motor to the spindle is by means of a flat belt. This machine is equipped with a 1/10-horsepower motor that is adapted for connection to a 110-volt direct-current circuit or to a 110-volt alternating-current, single-phase, 60-cycle circuit. When so desired, a 1/6-horsepower, 110- or 220-volt motor may be provided.

Multiple-spindle Drilling Machine: Hilldrill Co., 2141 N. 19th St., Philadelphia, Pa. A machine developed for use in simultaneously drilling a number of holes in structural steel members, although it could be used advantageously for the performance of many other classes of multiple drilling operations, among which mention may be made of work on ship and boiler plates, and other similar classes of work. In developing the design, extreme simplicity has been one of the chief aims, with the result that there is little chance of the machine giving trouble after it has been shipped to the consignee's plant. The spindles feed down automatically, and the work is clamped in place by a twenty-ton pressure which not only holds the piece to be drilled, but also will straighten out any ordinary irregularities in its shape. The drills are lubricated individually and the flow of lubricant is stopped when the machine stops running.

* * *

PARTIAL DISABILITY

BY CHESLA C. SHERLOCK

It is not a difficult matter, under the compensation acts, to determine the amount of the award due a workman who has suffered a total and permanent disability. The award is generally specifically fixed by express wording of the statute so as to remove all doubt as to the exact amount due. If a workman loses a leg, the law points out that in such a case the compensation shall extend over a certain period of weeks, regardless of the effect of such injury upon his earning capacity, it being assumed that such earning capacity has been impaired to the extent mentioned.

In the case of partial disability, however, the situation is entirely different. A workman may receive an injury which only partially disables him. Perhaps he has suffered no loss of earning power, but is able to continue in his employment without interruption. The question of whether he is entitled to compensation under the acts is a matter of very different consideration than when the injury is total and permanent.

For purposes of clearness, we will give a few examples in order that what is meant by the various terms, "total," "permanent," "temporary," and "partial" may be clearly understood. If a workman loses a leg, he suffers a "permanent" injury. That is, it is impossible for him ever to recover the use of the leg. In one sense, his disability is "total," at least, for such period of time as he is unable to resume his employment. If the injury is so bad that he will never be able to resume his employment, his disability is "total and permanent." In such case, he would be entitled to the full benefits of the statute. Suppose, however, that the loss of the leg impairs his usefulness in his employment for only a few weeks, considerably less than the term set out by the statute. In one sense, his injury is "permanent" but his disability is only "total and temporary" because he will recover his earning capacity in a few weeks.

In order to avoid confusion, it must be stated here that in the case of the loss of a leg the majority of courts and commissions have awarded the schedule amount of compensation and have not been disposed to differentiate between the degrees of disability. Perhaps it would be better to consider another form of injury, in order that no confusion may arise. A very good case is one where a workman cuts his finger. He may recover within two weeks and return to work. During the two weeks that he cannot work, his injury is only "temporary," but his disability is "total and temporary." If blood poison sets in and causes the loss of the finger, the hand, or the arm, his injury may become "total and permanent" or only "total and temporary" if he is, after a lapse of time, able to resume his employment, depending upon the facts in the case.

Because of the many turns which one simple injury may take there is often a hopeless confusion on the part of those concerned as to the meaning of disability and the extent to which recovery is to be had. In this sense, it may be said that if a workman has his finger, hand, arm, or leg completely severed at the time of the injury his award is much easier to fix than if the injury is a simple one, having complications that develop later. Because of the complexity existing, it is proposed to treat only of partial disability cases in this discussion.

Permanent Partial Disabilities

It cannot be doubted but that in certain cases injuries will affect a workman more or less the rest of his days. Such instances are known as permanent partial disabilities, and it is this class of injuries which the various acts seek to fix by a definite schedule of awards. This schedule, however, is not included in all the acts, many of them expressly stating that in the case of permanent partial disability proportional awards shall be made, based upon express awards given for permanent total disability, or upon estimated rates or percentages of the permanent partial disability to the total earning capacity of the workman prior to the injury. Thus, in some states, if it is thought that the loss of a finger impairs the earning capacity of a workman 5 per cent of what it was prior to the injury, this would be the extent of the award. If it is thought that the permanent partial disability is 50 per cent of what it would have been if the workman had lost the injured member, the compensation will be one-half the amount specified in the schedule for the loss of that member.

Impairment of Vision

A frequent case that is puzzling to employers and others is the case of impairment of vision. Most of the schedules allow compensation for the loss of an eye, but are silent as to what award shall be made in case the eye is only partially lost; that is to say, in case the vision of the eye has been partially impaired. This situation arose in Connecticut. It was found that all the commissioner could do was to award compensation for temporary total disability, that is, for the time actually lost from work and not upon the basis of any permanent impairment of vision. In this case, it was found, as a matter of fact, that the vision of the injured eye was impaired to the extent of 50 per cent. In another case in the same state, although it was shown that there was no impairment at that time in the earning power due to the partial loss of vision, the claim was allowed to remain active in the files and subject to revision, as it was felt that there might be a loss of earning power due to the impaired sight in the near future, and the case could then be reconsidered and the award changed.

In Pennsylvania, the statute contains a schedule award only for the loss of an eye, and it was held that in the absence of evidence showing loss of earning power, a proportionate award for the impairment of vision would not be authorized. In Illinois, the statute is similar to that in Connecticut, but the Industrial Board held that in the case of a partial loss of sight the award should be proportionate to the schedule amount given for total loss of the eye.

In Michigan a similar situation arose. The board allowed a proportional award based upon the schedule amount for the entire loss of an eye, but the Supreme Court disallowed the award, when it was shown that there had been no loss of earning power. In another case in the same state it was shown that the vision had been impaired 90 per cent but

that by the use of glasses such loss could be reduced to 50 per cent. The court held that it was the duty of the injured workman to avail himself of such a common appliance in order to reduce his loss as much as possible and that compensation would be allowed for loss of earning power, if any actually existed, and in case none existed the only compensation would be for actual time lost.

In Wisconsin a similar case arose. The court held that it could not sanction an award for loss of earning power when none had occurred, being unable to "take judicial-notice of the impairment of earning power in case of the loss of one eye." This opinion, however, was delivered by a divided court.

Compensation for Temporary Disabilities that Become Permanent Disabilities

When an award is made for temporary disability and the case later changes to become a permanent disability case, the question arises as to whether the full amount of the award allowed for total and permanent disability shall be paid in addition to the amount already paid for the temporary disability. Such a case arose in New York. A workman had been awarded compensation for temporary total disability due to an injury to his eye. Subsequent to the award, the workman lost the entire sight of his eye, the law allowing 128 weeks' compensation in such case. It was contended that this amount should be given in addition to the number of weeks' compensation already paid for the time that he had suffered temporary total disability, but it was held that the amount already paid should be deducted from the amount allowed for the total loss.

This decision is quite universally expressive of the feeling of the courts and commissions in such cases. To allow a workman to receive more than the law would allow if he had suffered the total and permanent injury in the first place is to clearly get around the plain intent of the statute. A workman might suffer temporary total disability for 127 weeks and then during the 128th week lose the entire sight of his eye (this is for purposes of illustration only), and then come in and claim 128 weeks' more compensation for his permanent total disability. This would not be administering the law in a spirit of true helpfulness, either to the workman or to the employer. It would, no doubt, encourage malingering in many instances.

In New Jersey, the law allows a schedule of awards for certain specified injuries and provides that all other injuries shall be compensated proportionately to the schedules. In a given case a workman was allowed more for a stiffened ankle than he would have received had his leg been amputated between the ankle and knee. The Supreme Court over-ruled his award, leaving it to the trial judge to determine if the proportion had been properly fixed.

This is another matter where errors are frequently made. It is obviously the purpose of the law to allow compensation in the greatest amount for the greatest injury. It must be assumed, that the greatest injury is the loss of the member itself. A man may in fact, be worse off when he does not lose the member than when he does, but, unfortunately the law does not, or cannot take that into consideration. Since the legislature has granted the most compensation for the loss of a member, it is obviously unfair to the employer to allow a workman who has not lost the member to receive more compensation than he would had the member been lost in the beginning.

This is a matter which will probably be argued until the end of time. There is argument on both sides. The writer has personally observed several cases where the workman was doubtless in a worse state than if he had lost the member entirely and where the unfortunate fellow was incapacitated from work for a period longer than that allowed to be compensable under the statute, but this does not alter the law. The employer may, and in most cases, does consent to pay additional compensation, not because he is required by law to do so, but because he feels a moral obligation.

Partial disability was never intended to be worth more than permanent disability. To say that it was is to invert the whole scheme of the compensation practice. That individual cases may come up where injustice is done is unfortunate, but such a contingency may arise in any field of human relation. Justice cannot be given equally to all in the same field at the same time and in the same way, although that is the high and lofty aim of modern jurisprudence.

Greatest Compensation for Greatest Injury

Some of the most difficult cases are where injuries cause the stiffening of fingers, joints, knees, or elbows. This class of injuries almost always produces temporary total disability. A man may have one finger stiffened and be partially disabled. He may be able to continue his work, but he cannot perform his duties as well as formerly. He has lost the use of the finger and it is worth no more to him than if it were off. If medical testimony supports these facts, compensation may be awarded for the total loss of the finger, even though it is still fastened to his hand.

Or, consider the case from another angle. Suppose, that the finger is more of a hindrance and impairs the workman's efficiency more than if it were amputated. It is sore, diseased, can never possibly be restored to normal usefulness by medical skill, and will always cause pain and suffering and will impair the workman's earning power for a longer period than if it were amputated. It is unquestionably the duty of the workman to have the finger amputated, thus saving his employer the additional compensation and restoring his own earning power as soon as possible.

* * *

ALUMINUM WELDING

In performing welding jobs, such as on aluminum crankcases, the following kink, given by a writer in the *Journal of Acetylene Welding*, can be used to advantage. Oftentimes it is required to weld a large hole, in which case a chill of galvanized iron is provided, backing up the hole and welding against this when filling the hole with aluminum. Galvanized iron is preferable to any other material, such as tin or iron, since it peels away from the aluminum quite readily, and can therefore easily be removed after the weld has been completed. This is undoubtedly due to the zinc content of the galvanizing composition.

The chief value of the use of the chill is that it causes the filler to cool and harden prematurely, thereby preventing it from contracting after the weld is finished. It also prevents the heat of the weld from spreading, which might cause the job to crack back. The chill is fastened in place by a wrought-iron strap, made in the shape of a boiler crab, which arches the hole. A hole is then drilled through the strap and a similar one through the galvanized iron plate, the two being fastened together by means of a bolt and nut. In making the weld, the metal is first applied to the inner corners and the space filled up by working toward the center. Just before the center is reached, and when it is impossible to add any more metal without touching the bolt, the strap should be loosened, the bolt removed, and the hole filled with the molten metal. Greater success will obtain if the work is done quickly, handling as large an amount of molten aluminum as possible at a time and covering the entire surface of the galvanized chill in a few minutes. The chill causes the added metal to cool almost as fast as it is connected to the edge of the break. After the weld has been finished and cooled, the chill can be removed by gently prying it away from the weld by means of a cold chisel. The flame of the torch should be kept in motion while performing the work and should not be pointed toward the weld, but rather across the melting portion; otherwise it is almost certain that the flame will not only injure the metal but will also burn away the galvanizing if pointed directly toward the weld.

Trend of the Machine Tool Market

General Conditions—Labor Market—British Embargo—Automobile Industry—Government-owned Machine Tools—Second-hand Market

TO what extent the machine tool business is settling down to normal conditions is somewhat difficult to predict, because great differences exist in various lines of machine tools. It is also difficult to determine what is at the present time meant by a normal business. In many cases, manufacturers have so increased their facilities that a business that would have been considered normal before the war is no longer adequate to meet the increased overhead expenses of the larger plants. Several manufacturers have stated that the orders received during January and the early part of February provided a business that was larger than their normal business previous to the war, but it was not a satisfactory business for the present size of their plant and their present facilities and organization.

On the whole, it may be stated that there appears to be a steady upward trend in the machine tool business since the beginning of the year. Some dealers report that business is approaching a normal volume. In addition, the inquiries for equipment are voluminous, indicating a great prospective demand for machine tools, and general activity in the industry. In New England this activity is especially manifest in the equipment required by hardware manufacturers and by the manufacturers of textile machinery. Considerable equipment has also been called for by shops making marine repairs. The automobile and truck business as well as the agricultural machinery business and the tractor factories are making extensive inquiries for new equipment. These industries doubtless will show a tremendous revival in a few months.

Buying is somewhat slow on account of present prices, but a great many manufacturers and dealers now guarantee that if their prices are reduced previous to July 1, the purchaser will receive as a rebate the difference between the present prices and the price on July 1. It is not generally expected, however, that prices will drop for some time to come, because materials and labor are still practically as high as during the war period. In a few instances, manufacturers have reduced prices, but the reduction is more in the nature of an equalization with the prices of similar machines made by other makers rather than in the nature of a cutting of prices. One manufacturer reports that his sales have been considerably stimulated by a price reduction of about ten per cent.

Will Reduction of Raw Material Prices Stimulate Trade?

Immediately after the armistice was signed in November, dealers in steel, copper and other raw materials were inclined to receive with disfavor any suggestions relative to the cutting of prices of these commodities. The claim was made that the existing scale of wages and other items in the cost of production fully justified the quotations which they were making for future business; but as time went on and buyers continued to show a tendency to wait for a lower level of the market, quotations were reduced; and it now appears probable that further concessions will have to be made before orders for deferred delivery will be placed in any considerable volume. From the standpoint of all concerned, it is to be hoped that the prices of materials and equipment used in metal-working plants will be brought to the normal point as quickly as possible. Nothing will have a greater influence upon the state of trade in these industries than a reduction of the cost of such raw materials as iron and steel to a figure where buyers will feel justified in entering upon commitments for their future requirements. Such a stimulation of business would be reflected in an increased demand for machine tools and other equipment and supplies required for carrying on manufacturing operations.

The Labor Market

While the cessation of hostilities and the consequent reduction in the manufacture of war materials immediately released a great number of men, there is still so great a demand for experienced mechanics that, in the industrial centers, there is no surplus of skilled men, and wages still remain as high as during the war period. It is stated that there are any number of helpers and second-class men to be had, but first-class machinists and toolmakers are still at a premium. As long as the present wage scales remain, therefore, prices cannot be materially reduced, if at all. The reduction in the prices of material also has, so far, been so slight as not to materially affect the selling prices. Furthermore, the reduced output of most plants makes it necessary to charge a greater part of the overhead burden to each individual machine, and this, in turn, tends to make it necessary to retain the present prices of the product.

The British Embargo

The British embargo is not going to affect the American machine tool trade seriously. As explained in an editorial on page 596, the embargo is not intended to exclude American machine tools from the British market, but merely constitutes a form of control which has been deemed desirable and under which established British importers will be permitted to continue to import a large amount of machine tools. The French situation is, in fact, more serious than the British, because the French authorities for some time have taken the position that France can manufacture the greater part of the machine tools required during the reconstruction period. This idea is obviously erroneous, but it nevertheless seriously affects the export trade to France at present. This subject is dealt with in greater detail in an article, "American Machine Tools in France," page 654.

The Trend of the Automobile Industry

Great activity is reported in the automobile industry, and automobile manufacturers are planning for big production during 1919. A great demand for machine tools may, in fact, be expected from this industry, as soon as the conditions are favorable for heavy buying. As a rule, however, the automobile industry, has not as yet entered upon large-scale production, because a drop in the prices of materials is anticipated, and considerable pressure is brought to bear both upon the makers of the raw materials and upon the makers of parts and supplies to reduce prices. In fact, some makers of parts state that the prices offered by the automobile builders leave them no profits, with the present prices of materials and labor, but that they have to accept contracts at prices offered in order to keep their plants going. The object of the automobile manufacturers is doubtless to endeavor to reduce the prices of cars and trucks in order to thereby stimulate the market, and in order to be able to so reduce prices, they, of course, must obtain their material and parts at a reduced cost. Whether this policy is a good one is doubtful, because if the makers of materials and parts have to accept contracts at too low figures merely in order to keep their plants going, there naturally will be attempts made to meet the reduced prices in some other way, sometimes at the expense of quality.

The Effect of Government-owned Machine Tools

The most serious condition faced by the machine tool builders and dealers is the question of how the machine tools owned, but now not needed, by the Government will be disposed of. Most manufacturers favor the proposal of turning these machines over to the trade and technical schools, as exhaustively dealt with in an article by A. E. Newton, president of the American Machine Tool Builders' Association, on another page of this number. Should Congress not accept this proposition, however, the trade generally favors a procedure whereby the Government just as soon as possible disposes of all the machine tools for which it has no further use in the arsenals or navy yards, so that the effect of the dumping of this large number of machine tools on the market might be passed over just as soon as possible. As long as it is known that there is likely to be a large number of Government-owned machine tools offered within a reasonable time, this will have a very serious effect upon the market conditions. With these machines once out of the way, the manufacturer will know exactly where he stands, and the Government could do no better service to the general industrial revival of the mechanical trades than to act promptly, no matter along what line it proceeds.

Importance of Keeping Machine Tool Trade Employed

The Government should not overlook the importance that ought to be attached to keeping the machine tool trade employed. This trade is the fundamental and basic mechanical trade, and it may be said, without exaggeration, that the high standard of the machine building and mechanical trades in general in the United States is due in no small measure to what has been done in the machine tool trade in the way of improving designs of machinery, devising new and better methods, and training mechanics. The power of our machine industries to compete in the world's markets, therefore, depends largely upon the prosperous condition of the machine tool industry. If machinists and toolmakers are released from this industry, they will gradually drift into other occupations and their long years of training and experience, which are a national asset, will be lost.

Our power to compete in other industries, such as the automobile industry, for example, has largely been due to the methods and machines developed by the machine tool builders. As an example may be mentioned the case of grinding machines which have been brought to their present high perfection by the machine tool builders in this line, and not by the manufacturers of automobiles or other products, who are users of these machines and who have been able to reduce costs and successfully compete in the world's markets because of the methods introduced by the use of grinding machines. The same holds true of a great number of other machine tools. There is no doubt that it was the machine tool industry in Germany that made it possible for that nation to hold out against the world as long as she did. Without the machine tool industry as the fundamental mechanical industry, Germany would doubtless have been defeated long ago.

Hence, our Government should take great care not to harm this basic industry by any inadvisable method of disposing of the machine tools now in the Government's hands. It is not the interests of the machine tool manufacturers alone that should be protected in this instance, but it is also a case of looking out for the great number of men employed in this industry, so that their experience and training may be preserved as a national asset. Should these men temporarily be forced to leave the mechanical industries, it is likely that they will be permanently lost to it, and it would be better for the Government to accept a temporary pecuniary loss in the disposal of the machine tools on its hands than to cripple one of the fundamental industries of the nation.

It is also of great importance that the Government settle as soon as possible all claims against it, on account of cancellations, that are presented by both machine tool builders and other manufacturers. If this is not done, the Government will place many manufacturers in financial difficulties which, in turn, will lead to depression in the industry—a depression that is wholly unnecessary and which could be avoided by quick action on the part of the Government.

Second-hand Market in Machine Tools

The apprehension that a second-hand market in machine tools would be abnormally large and that the trade in used machinery would seriously affect the trade in new machines has not so far materialized. Of the second-hand machines offered to dealers, it is stated that only twenty-five per cent is of a quality that the dealers care to handle. The other seventy-five per cent has been so roughly used, or is so old and worn out, that it is only fit for scrap. As the government-owned machines have not yet been offered in any large quantities in the open market, the second-hand market is merely normal, and has had no serious influence on the machine tool market. Manufacturers with an established business are keeping the new and high-class machine tools which they acquired during the war period, and are offering for the second-hand market only the old machines which they do not find advantageous in their own line of manufacture, because of the reduced efficiency of these machines. It is only in the case of firms who were newly established and went into the business of manufacturing war materials exclusively that the equipment of whole shops, including some fairly new machines, is being offered. In cases where good machines are offered, the price, however, is quite high; so high, in fact, that dealers sometimes have to refuse considering the offers.

Reports of Good Business

Several manufacturers report that their volume of business for January and February has been so satisfactory that if the same volume of business keeps up throughout the year they will have as good a year as 1918. The Oliver Machinery Co., Grand Rapids, Mich., for example, writes as follows:

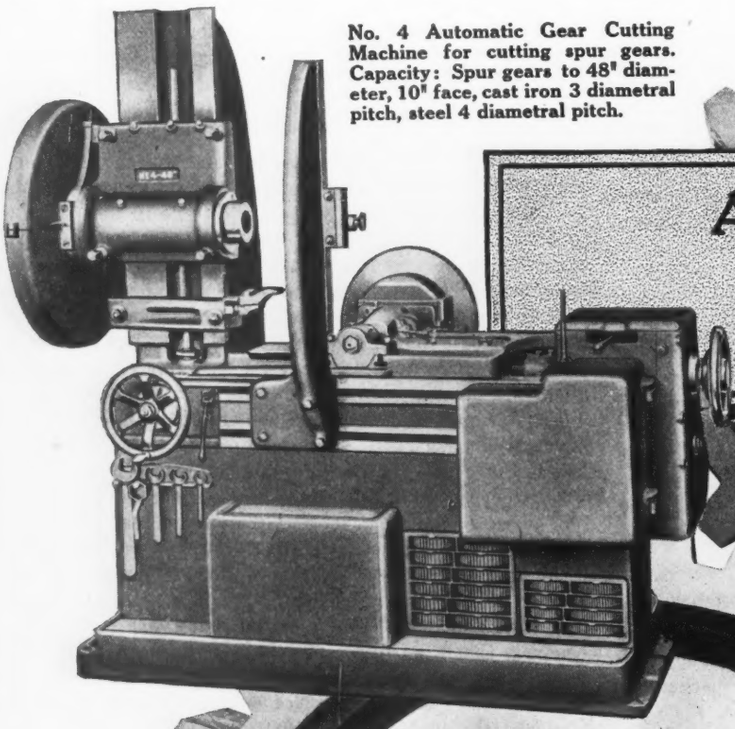
> The month of January, 1919, showed the biggest shipments the Oliver Machinery Co. has made in its history. Part of this is due, without question, to the fact that our export business has replaced some of the domestic business of previous months. Old export orders were filled because of improved shipping conditions.
>
> Orders received during the month of January were also very gratifying, being within 10 per cent of our average monthly business for the past year. While a part of our business, and we might say a substantial part, is export, at the same time, whenever we receive an order for a carload of machinery for export, we have to purchase a certain amount of steel, which purchase is domestic business. We have to purchase almost a carload of cast iron, which is indeed domestic business.
>
> We hope that other people who are actually enjoying a good volume of business will publish the fact in the hope that those who are putting off purchases unnecessarily will see the error of their ways.

Reports on Specific Lines of Machines

Milling Machines—Both builders of milling machines and dealers report a brisk demand for this type of tool. Inquiries seem to be well distributed, and two explanations may be made for their existence at the present time. In some cases, inquiries are coming from the so-called "non-essential" industries which were prevented from buying machinery during the war; and the other source of inquiries is from those manufacturers who sold their milling machines second-hand during the war and are now buying new machines for about the same price or even at a lower figure.

Small Tools—The demand for all classes of small tools is said to be decidedly satisfactory. Not only are manufacturers receiving orders for tools to replace the depleted stock of the dealers, but both the manufacturers and dealers are doing a volume of business over the counter which is well up to an average figure.

Gear-cutting Machines—There is a good demand for gear-cutting machines, much of this business coming from build-



No. 4 Automatic Gear Cutting Machine for cutting spur gears. Capacity: Spur gears to 48" diameter, 10" face, cast iron 3 diametral pitch, steel 4 diametral pitch.

A Few Seconds of Each Decided Gain

Brown & Sharpe Automatic Gear Cutting Machines

"Built to Stand The Steady Drive of The Busy Shop"

Information In Detail On Request

Specify B&S Machines

BROWN & SHARPE MFG. CO.,

OFFICES: NEW YORK, N. Y., 20 Vesey St. PHILADELPHIA, PA., 1103-1105 Liberty Bldg. CHICAGO, ILL., 626-630 Washington Blvd. ROCHESTER, N. Y., 415 Chamber of Commerce Bldg. SYRACUSE, N. Y., Room 419 University Block. PITTSBURGH, PA., 2538 Henry W. Oliver Bldg. CANADIAN REPRESENTATIVE: MONTREAL, TORONTO, WINNIPEG, CALGARY, VANCOUVER, ST. JOHN, SASKATOON, The Canadian Fairbanks-Morse Co., Ltd. REPRESENTATIVE IN AUSTRALASIA: R. L. Scrutton & Co., Ltd., Sydney, N. S. W.

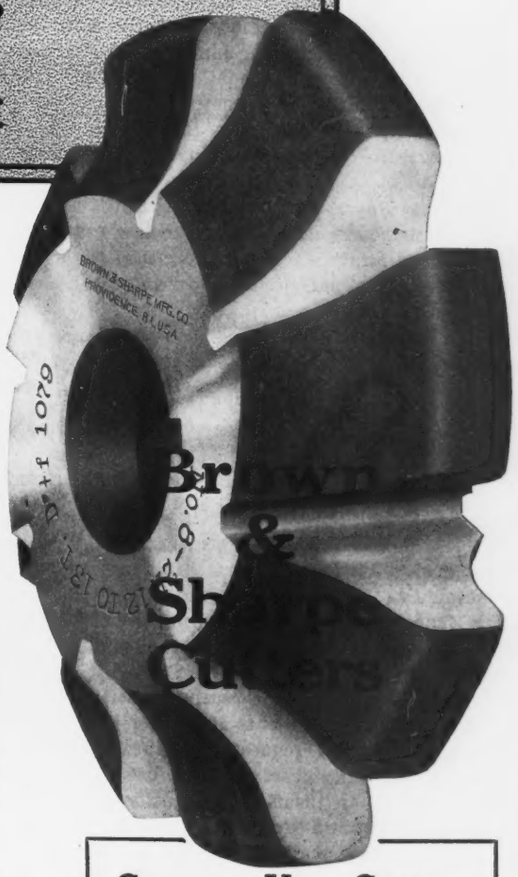
Saved in the Cutting Tooth Makes a in the Day's Output

SAVING the seconds is what counts on production records. B & S Automatic Gear Cutting Machines are second-savers from the start. To begin with, the arrangement of the various parts insures ease and simplicity of operation with full control from front of machine. Cutter slide advances and returns cutter rapidly and at a constant speed regardless of speed or feed of cutter. Indexing is also independent and at a constant speed insuring rapid indexing. If you cut gears and want fast production with accuracy you should consider

BROWN & SHARPE Gear Cutting EQUIPMENT

Small in comparison with the machine but great in importance are the cutters you use. B & S Cutters produce correctly formed teeth as long as they are in service and stand up under "the steady drive of the busy shop" for long periods between resharpenings.

Brown & Sharpe Machines and Brown & Sharpe Cutters make the production-boosting combination which present conditions demand.



Conserve Your Cutters

You can rough out gear teeth at a surprising speed by using

B & S Stocking Cutters

The alternate stepped teeth break up the chips, making the cutter action easier and thus lessening the stress on the machine.

When blanks are roughed out with these cutters only a light finishing cut is required of the finishing cutter, conserving its life and accuracy.

Write for Catalog 27

Specify B&S Cutters

Providence, R. I., U. S. A.

REPRESESNTATIVES: BALTIMORE, MD., Carey Machinery & Supply Co. CINCINNATI, O., INDIANAPOLIS, IND., The E. A. Kinsey Co. SAN FRANCISCO, CAL., Pacific Tool & Supply Co. CLEVELAND, O., DETROIT, MICH., Strong, Carlisle & Hammond Co. ST. LOUIS, MO., Colcord-Wright Machinery & Supply Co. SEATTLE, WASH., Perine Machinery Co. PORTLAND, ORE., Portland Machinery Co.

ers of automobiles and from plants which are either building tractors or are being equipped to engage in that line of manufacture.

Engine Lathes—The consensus of opinion seems to be that there is an over-production of many sizes of engine lathes. So far as lathes are concerned, the best demand is for the larger sizes of heavy-duty machines.

Planers—There appears to be little demand for planers at present, except where manufacturers have export orders.

Hand Screw Machines and Turret Lathes—Manufacturers of this type of machine tool report a fairly large volume of inquiries during the months of January and February, most of which emanate from automobile and tractor industries, and from manufacturers of agricultural implements. A fair volume of orders has come from these inquiries, although possibly the ratio of orders to inquiries is slightly below normal.

Punches and Shears—It is quite generally reported that there is a satisfactory demand for punches and shears, particularly of the larger sizes and capacities, for use in shipyards, boiler plants, and other shops where these machines are required.

Grinding Machines—There is said to be a large volume of inquiries received chiefly from the automobile and tractor industries, many of which have resulted in the placing of orders.

* * *

PACKING AND MARKING OF EXPRESS SHIPMENTS

A nation-wide campaign to put an end to the waste attributed to inadequate packing, wrapping, and marking of express shipments has been inaugurated by the American Railway Express Co., which is handling the express business on practically all the railroads of the country. No new packing or marking rules have been adopted for the campaign, but express drivers and receiving clerks in the larger cities, as well as express agents at smaller points, have been instructed hereafter to request that the rules already in force be more carefully observed. The use of a poor quality of paper or twine, an insufficient quantity of wrapping material, and incorrect and careless addressing have been found to be responsible for many shipments going astray. Additional causes for this condition are said to be the employment of old or second-hand cartons or other containers that cannot stand the wear of transit, resulting in exposure of the contents and possible damage to the goods, or pilfering. Old marks cause confusion and mistakes in delivery.

A determined effort will be made during the campaign to eradicate what is known as the "No Mark" evil. From July 1 to November 30 of last year, 127,859 shipments—an average of about 25,500 a month—were turned over to the "No Mark" bureaus maintained by the company, because all means of identification of either shippers or consignees had been lost, and delivery, except in a few cases, was impossible. Personal baggage, hardware, and automobile tires comprise the largest proportion of the "No Mark" shipments which are attributed largely to the failure of the shippers to mark clearly and to pack their goods substantially.

* * *

The United States Bureau of Mines has recently conducted a research on the practicability of substituting niter-cake for sulphuric acid in baths for pickling steel and iron. It was found that the free acid in hot dilute solution attacks the metal very readily, etching it away from beneath the scale and consequently throwing off the particles of oxide from the surface. However, one of the objections to its use is that the vapors arising from the solution carry off a quantity of acid in finely divided particles, which are detrimental to the health of the operatives and injurious to the metal work and machinery installed in the building. Experiments have been conducted for the purpose of devising some means of overcoming the difficulties experienced.

THE TAX ON THE SPREADING OF KNOWLEDGE

Statistics based upon official sources, covering years of post office experience, clearly indicate that, with an increasing volume of periodicals and newspapers carried by the post office department, there was a decreasing postal deficit. By throttling the easy circulation of periodicals and newspapers throughout the nation, as is now being done by the inequitable postal rates for second-class matter, postal receipts are decreased in the aggregate, and the deficit of the postal department is likely to increase; and, what is far more important, the great intellectual arteries of civilization, whereby our nation has become unified and made one in its social, economic, and political ideals, are choked. It is in the interest of every citizen of the United States to see that the periodicals that carry an educational message, whether in the mechanical or other lines, should be fairly treated, and that the postage rates are made equal throughout the nation—equal, equitable, and just. Your congressman should know how you feel about this, and should be informed of the great educational value of the mechanical periodicals for which you subscribe. A letter from you, telling him that you believe that the second-class postage rates (which are now, in some cases, higher than the actual subscription price of the magazine) are utterly unjust and unwarranted, would help a great deal to remedy the wrong conditions that now prevail.

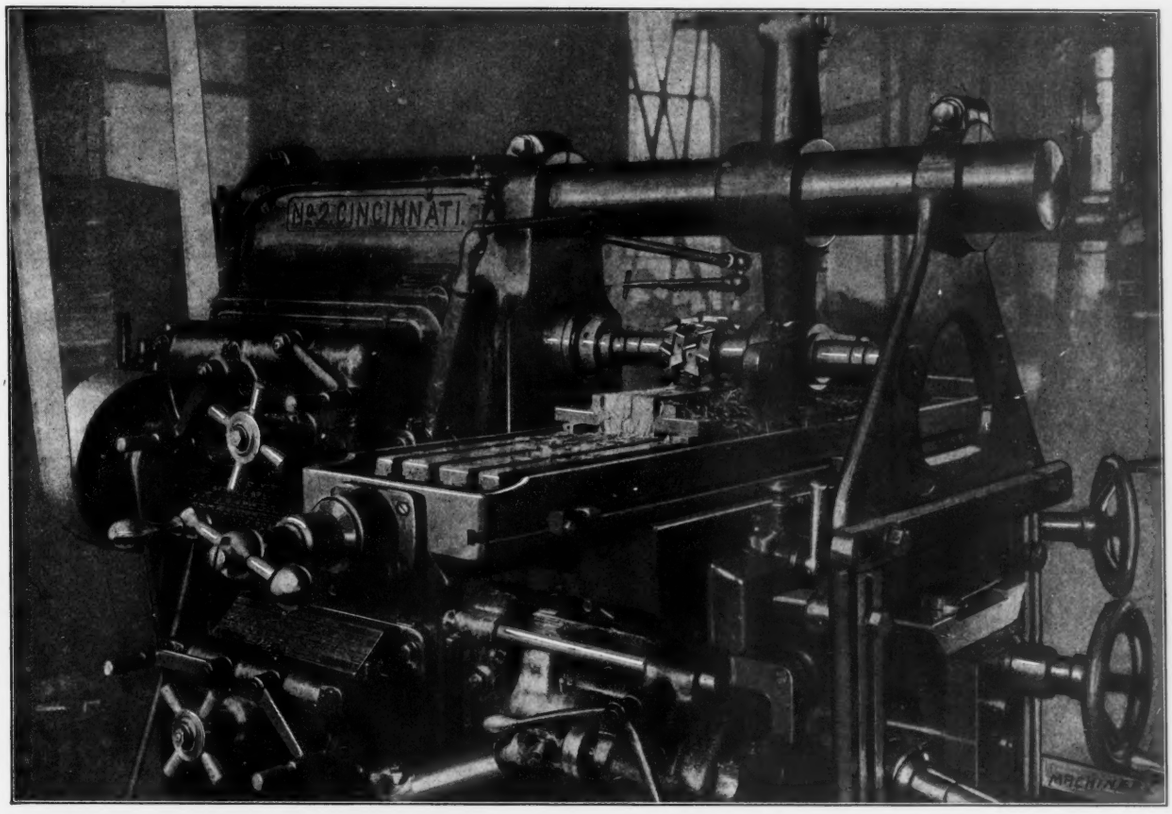
* * *

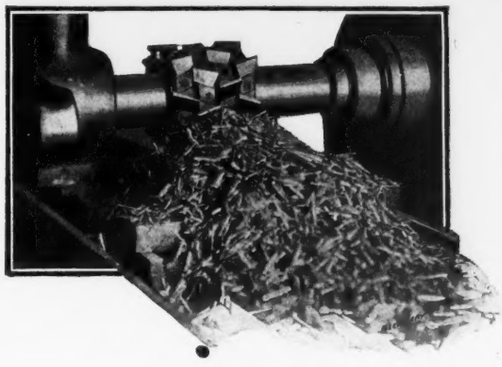
AMERICAN STEEL TREATERS' SOCIETY

The American Steel Treaters' Society has recently been organized in Chicago, with the object of promoting the arts and science connected with the heat-treatment of steel. The principal means of accomplishing this purpose will be the holding of meetings for the reading and discussion of papers bearing upon processes, instruments, equipment, apparatus, etc., employed in practical and research work connected with the heat-treatment of steel, and the collection, publication, and dissemination of technical and practical knowledge for the improvement of conditions in connection therewith, in order to closely unite those engaged in the practical and technical branches. It is one of the aims of the society to induce the workers in the heat-treating rooms of the various industries to attend its meetings, where they will come into contact with metallurgists, chemists and scientific men, and thus bring together the practical and theoretical sides of the work. Although in existence only a few months, the growth of the society has been very rapid, and movements are on foot to organize branches in several of the principal cities, a branch with a large membership having recently been formed in Cleveland. The society publishes a monthly *Journal* which contains the papers and discussions presented at the various meetings. Copies of the *Journal* and other information may be obtained by addressing the general office, 154 E. Erie St., Chicago, Ill.

* * *

One of the much debated questions in the post-war industrial readjustment, is that of wages. High cost of living, such as experienced during the war, naturally entails higher compensation for the same standard of efficiency as previously obtained; but workers will be unwilling to return to lower compensation for their services even when, in the natural course of events, living costs are reduced considerably. One solution of the problem, according to the National Industrial Conference Board in its report on "Problems of Industrial Readjustment in the United States," is an increase in the efficiency of individual production to such a degree that employers will be warranted in paying relatively high wages. This, says the report, seems to be the only means of escaping the vicious circle by which an increase in the cost of living is used as a reason for demanding higher wages which, in turn, increases the cost of commodities.





The Cincinnati No. 2 Plain High Power Milling Machine

Send us your blueprints or samples and let us estimate production on your work.

The Cincinnati No. 2 Plain High Power Milling Machine takes this cut in steel 3½″ wide, 1/8″ deep, at 12½″ feed. This is not the limit of the machine, but merely an example of good commercial milling.

In Cincinnati High Speed Power Millers are combined the advantages of unsurpassed milling capacity and accuracy of production.

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI OHIO, U. S. A.

OBITUARIES

GEORGE KINNE GARVIN

GEORGE KINNE GARVIN, president of the Garvin Machine Co., 114 Varick St., New York City, died at his home in Garden City, L. I., February 20, of arterio-sclerosis, after an illness of two weeks. Mr. Garvin had been in failing health for nearly a year, but had maintained his activities with the concern of which he was the head until his last illness. He was born in Hartford, Conn., May 2, 1859. His family later removed to Jersey City, N. J., where he received his education at Hasbrouck Institute of that city and in the public schools of New York City. He entered business at the age of sixteen in the firm of Smith & Garvin of which his father, the late Hugh R. Garvin was a member. The Garvin Machine Co., which is an outgrowth of the older organization, was incorporated in 1889 with Mr. Garvin as president, in which capacity he had been active up to the time of his recent illness. Mr. Garvin is survived by a widow and six children, two of whom, Burr K. and Hugh Roy Garvin are at present connected with the concern in executive capacities. Mr. Garvin was a member of the American Society of Mechanical Engineers and of the Engineers Club of New York City and was widely known, through his prominence in engineering circles, for his business and mechanical ability.

FRED L. HICKOK

FRED L. HICKOK, president of the Reliance Gauge Column Co., of Cleveland, Ohio, died on February 16 of pneumonia, following a week's illness with influenza, thus suddenly ending a life full of promise. Mr. Hickok was born in Ashtabula, Ohio, in 1883, and was educated there and in Cleveland, being a graduate of Case School. Afterward he went to the Ingersoll Milling Machine Co., Rockford, Ill., of which his uncle, Winthrop Ingersoll, is president. He was with this company about eight years, rising to the position of sales manager, which he resigned to become manager of MACHINERY'S Cleveland office. In this position, which he filled for four years, his ability, engaging personality and general mechanical knowledge enabled him to achieve a marked success. About a year ago Mr. Hickok was offered the presidency of the Reliance Gauge Column Co., with a substantial interest in the business, and left MACHINERY, to the regret of his associates, but with their hearty wishes for his success. Mr. Hickok had many qualities that make for success. He was an enthusiast in his work, and made and held many warm friends, both personal and business, who will grieve at his death. His domestic life was unusually happy, and his home and family were typical of the highest American ideals. Mr. Hickok was in his thirty-sixth year and left a widow and three young children.

J. J. McCABE

J. J. MCCABE, of the J. J. McCabe Lathe & Machinery Corporation and one of the well-known men in the machine tool industry, died on January 17. As a dealer, Mr. McCabe, from time to time, handled the New York agencies of many well-known manufacturers of machine tools, including Schumacher & Boye; Smith & Mills Co.; Carlton Machine Tool Co.; and G. A. Gray Co. In the used machinery business, Mr. McCabe was one of the pioneers for nearly thirty-five years. When E. P. Bullard founded the Bullard Machine Tool Co., of Bridgeport, Conn., devoted entirely to manufacturing, Mr. McCabe succeeded the old New York firm of the E. P. Bullard Co., who were machine tool dealers, and with whom he had been associated since boyhood. As a manufacturer, Mr. McCabe was identified with the well-known "Two-in-One" double-spindle lathe, which he personally designed and which was manufactured under his patents for years. A few years ago, he also founded the present J. J. McCabe Punch & Shear Co., the plant of which is located at Chattanooga, Tenn. Mr. McCabe made many warm personal friends during his long connection with the machine tool industry, to whom his death will be a heavy loss. He leaves a widow and four children. Two of his sons, J. J. McCabe, Jr., and Raymond J. McCabe, have been associated with him in business for a number of years, and under their able management the organizations of the J. J. McCabe Lathe & Machinery Corporation and the J. J. McCabe Punch & Shear Co. will be continued.

HERBERT WOODRUFF MERRILL, secretary and treasurer of the firm of Mitts & Merrill, Saginaw, Mich., died on January 26, 1919.

PERSONALS

FRANK C. AVERY has resigned his position as general manager of the Long & Allstatter Co., Hamilton, Ohio.

H. W. ULLMAN has been appointed sales representative of the Rich Tool Co., Chicago, Ill., in the St. Louis territory, with offices at 203 Security Bldg., St. Louis, Mo.

FRANK RAYBOULD, formerly with the New England Westinghouse Co., Chicopee Falls, Mass., is now with the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

W. H. SHERMAN, formerly superintendent of the Davis Machine Tool Co., Inc., Rochester, N. Y., is now superintendent of the Superior Machine Tool Co., Kokomo, Ind.

NORTON A. BOOZE, for a number of years secretary of the Machinists Supply Co., has become affiliated with the Federal Machinery Sales Co., 12 N. Jefferson St., Chicago, Ill.

LEON A. HART, formerly industrial engineer with the New England Westinghouse Co., Chicopee Falls, Mass., is now engaged in consulting engineering work in Hartford, Conn.

J. L. CROWLEY has been appointed special railroad representative of the Rich Tool Co., Chicago, Ill., with headquarters at the company's main offices, Railroad Exchange Bldg., Chicago.

GEORGE F. HOPKINS, for the last ten years superintendent of the Frost Gear & Forge Co., Jackson, Mich., has been made works manager of the Logansport Machine Co., Logansport, Ind.

ALDEN R. LUDLOW, formerly vice-president of the Liquid Carbonic Co., Chicago, Ill., has assumed his new duties as second vice-president of the Air Reduction Co., Inc., 120 Broadway, New York City.

GEORGE D. PORTER of Philadelphia has been elected president of the American Bronze Corporation, Berwyn, Pa., succeeding John W. Watson who has severed his active connection with the company.

ALBERT V. BROUILLETTE, formerly industrial engineer with the New England Westinghouse Co., Chicopee Falls, Mass., is now engaged in doing efficiency work as a consulting engineer at Central Falls, R. I.

FRANK D. JENKS has left his position with the New England Westinghouse Co., Chicopee Falls, Mass., owing to the completion of the war contracts filled by this company, and is now with Bardons & Oliver, Cleveland, Ohio.

EDWARD W. DODGE, for many years connected with the Norton Co., Worcester, Mass., acting as sales manager a large part of the time, has become general sales and works manager of the Star Corundum Wheel Co., Detroit, Mich.

A. C. OLFS, formerly eastern representative of the Titanium Bronze Co., has become Michigan representative for the Stewart Mfg. Corporation, Chicago, Ill., manufacturer of diecastings. A sales office has been opened at 1509 Kresge Bldg., Detroit, Mich.

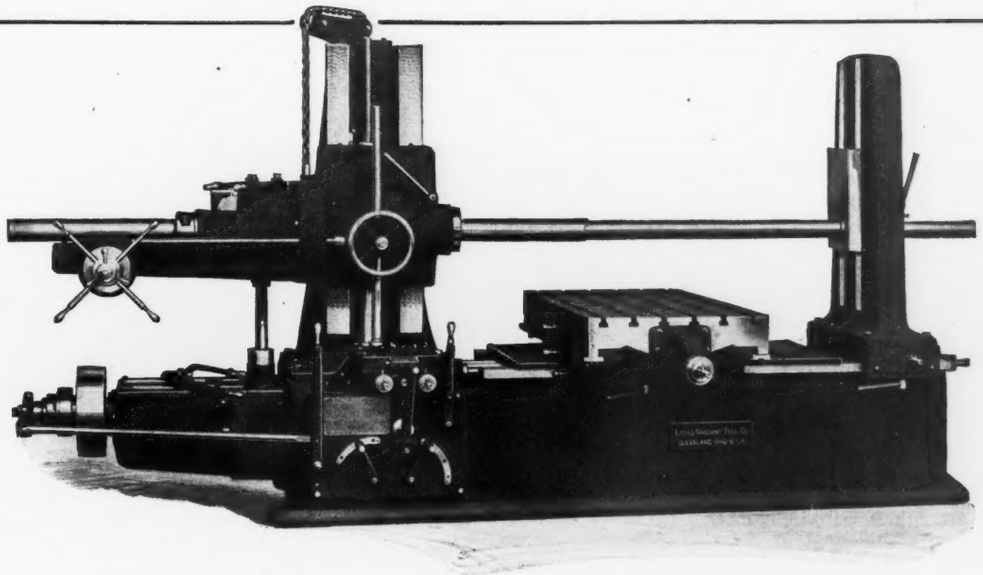
CHARLES H. BAKER, formerly associated with the Timken Roller Bearing Co., Canton, Ohio, has been elected assistant secretary and treasurer of the American Bronze Corporation, Berwyn, Pa., and in addition to his financial duties will be in charge of production.

EDWIN G. ANDERSON, advertising and sales manager of the American Bronze Corporation, Berwyn, Pa., has been elected secretary of the company. Mr. Anderson has been connected with the company for several years, originally acting as Pacific coast representative.

E. R. ABBOTT has been discharged from the Chemical Warfare Service of the United States Army, in which he held the rank of Captain, and is now sales manager of the Kar Engineering Co., Inc., 79 E. 130th St., New York City, mechanical engineers and machine designers.

O. S. HORTON has recently been made manager of the southern branch of the Edward R. Ladew Co., Glen Cove,

"Learn from THINGS—not from the NAMES of things"



You have seen the name "PRECISION" advertised many times—If you are one of the comparatively few who have not seen the

"PRECISION"

Boring, Drilling and Milling Machine

Why not look it up?
Very many are in use—
so there is one (or more)
somewhere near you.

LUCAS MACHINE TOOL COMPANY

NOW AND ALWAYS OF

CLEVELAND, OHIO

N. Y., manufacturer of Ladew leather belting. Mr. Horton's headquarters are at Charlotte, N. C., where a large stock of Ladew belting will be carried. WALTER CARR, formerly of the New York office, is assistant branch manager.

R. G. AMES has become associated with the Black & Decker Mfg. Co., Baltimore, Md., in the capacity of branch manager, in charge of the Chicago office. Mr. Ames is well known in the automobile accessories trade, having been connected with the Edward A. Cassidy Co., of New York, for the last ten years.

MATTHEW C. DITTMANN has been re-elected vice-president and treasurer of the American Bronze Corporation, Berwyn, Pa., and has also been appointed general manager to succeed John W. Watson. Mr. Dittmann has been associated with Mr. Watson practically since the formation of the American Bronze Corporation in 1906, and has been largely responsible for the progress and expansion of the business.

ALFRED H. BARTSCH has been appointed general sales and advertising manager of the Bosch Magneto Co., 223 W. 46th St., New York City. Previous to the war, Mr. Bartsch had been advertising manager of the Bosch Magneto Co. for more than seven years. For the past two years, he has been located in Philadelphia, where he represented a number of prominent firms of the automotive industries as merchandising and advertising counsel.

PAUL CAMPBELL has been appointed factory manager of the Electric Service Supplies Co., Philadelphia, Pa. During the greater part of 1918, Mr. Campbell was connected with the New York district office of the Bureau of Aircraft Production as a special investigator of production problems in the New England states, and previous to that was production manager for James Cunningham Son & Co., of Rochester, N. Y., and superintendent of the F. B. Stearns Co., of Cleveland, Ohio.

JOHN W. WATSON, since 1906 president and general manager of the American Bronze Corporation, Berwyn, Pa., has resigned from the presidency of the corporation and also from active management in the business. Mr. Watson retains his holdings in the corporation and will continue to serve on the Board of Directors. His plans for the future have not been definitely fixed. Matthew C. Dittmann, who has been re-elected to the office of vice-president and treasurer and who has also been appointed general manager, has acted in the latter capacity for some time past, as Mr. Watson some months ago entered government service, first as Director of Publicity for the Philadelphia Ordnance District and later as Assistant Chief of the Hispano-Suiza Engine Section of the Bureau of Aircraft Production.

* * *

MONTHLY MEETING OF THE NEW YORK SECTION OF THE A. S. M. E.

The monthly meeting of the New York Section of the American Society of Mechanical Engineers held in the Engineering Societies Building, 29 W. 39th St., New York City, February 24, offered much of interest to the engineers belonging to the section as well as to visiting engineers. The meeting began at 5:30 P. M., when a paper on "The Application of Electrical Control to Gate Valves," illustrated by lantern slides, was read by Peter P. Dean, engineer of the Cutler-Hammer Mfg. Co., Milwaukee, Wis. After a buffet supper, a paper was read on "The Application to Industry of the Personnel Work in the U. S. Army," by Lieutenant-Colonel J. J. Swan, who explained how the valuable experience gained by the Committee on Classification and Personnel of the War Department may be applied to the industries. Finally, motion pictures of mechanical drawings for commercial and scientific use were shown, covering Burrows adding machine; Ingersoll-Rand riveter; automobile gas engine; why the telephone talks; Lewis machine gun; the airplane in warfare; and electrical starting and lighting systems.

COMING EVENTS

March 5—Annual meeting of the Boston branch of the National Metal Trades Association, at Boston, Mass.; headquarters, Young's Hotel. Secretary, George D. Berry, 166 Devonshire St., Boston, Mass.

March 12—Monthly meeting of the New England Foundrymen's Association, at Boston, Mass. Secretary, Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

March 27—Monthly meeting of the Rochester Society of Technical Draftsmen, in Rooms 131-137 Sibley Block, 328 Main St., E., Rochester, N. Y. Secretary, O. L. Angevine, Jr., 857 Genesee St., Rochester, N. Y.

April 24-26—Sixth National Foreign Trade Convention, at Chicago, Ill. Secretary, O. K. Davis, 1 Hanover Square, New York City.

June 17-20—Semi-annual convention of the American Society of Mechanical Engineers, at Detroit, Mich. Secretary, Calvin W. Rice, 29 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

National Machine Tool Builders Association, official report of the proceedings of the seventeenth annual convention held at the Hotel Astor, New York City, December 10-11.

Rochester Society of Technical Draftsmen, at its last meeting, elected the following officers for 1918-1919: Hugh Davis, president; Orrin S. Chase, vice-president; O. L. Angevine, Jr., secretary; and Walter B. Payne, treasurer.

University of Illinois, Urbana, Ill., announces that in order to assist in the conduct of engineering research and to extend and strengthen the field of its graduate work of engineering, fourteen research graduate assistantships are maintained in the Engineering Experiment Station. These assistantships, for each of which there is an annual stipend of $500 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities who are prepared to undertake graduate study in engineering, physics, or applied chemistry. Further information relating to this subject may be obtained by addressing the director, Engineering Experiment Station, University of Illinois, Urbana, Ill.

BOOKS AND PAMPHLETS

Industrial Arts Index. 1918 volume. Edited by Charlotte G. Noyes and Louise D. Teich. 528 pages, 6½ by 10 inches. Published by H. W. Wilson Co., 960 University Ave., New York City.

Man-to-man. By John Leitch. 249 pages, 5 by 8 inches. Published by B. C. Forbes Publishing Co., 297 Broadway, New York City. Price, $2.

This book deals with the relations between employer and employe, the object being to show that both capital and labor depend upon cooperation with each other for their prosperity. The scope is well indicated by its chapter headings: The Factory Worker of Today; Why Men Strike; Building Men to Build Pianos; Out of a Confusion of Tongues; The Supervision that Counts; Must a Foreman be a Pugilist?; Industrial Democracy, the Employes, and the Unions; Industrial Democracy and the Employer; Keeping Alive the Community Spirit; Putting Labor Behind America. The author, in his introduction to the book, points out that we have need for the brains as well as the hands of all who are able to work. In the past, he says, we have had only "hands"; it is high time that we should also have the brains— the complete cooperation of the men working in the industries.

Drafting-room Methods. By Charles D. Collins. 149 pages, 5½ by 8¼ inches. Numerous illustrations. Published by D. Van Nostrand Co., 25 Park Place, New York City. Price, $2.

This book is intended mainly as a reference work on standards and forms for engineering offices and draftsmen. The object is to provide a set of standard practice sheets, such as every large concern operating a drafting-room has gradually compiled for itself in the past, and the book, therefore, describes methods and illustrates forms which would be generally applicable in engineering offices and drafting-rooms, combining with this information the conventional symbols or standards for different branches of engineering drafting. The book is divided into four parts, the first of which deals with methods of the drafting-room; the second, with standards, symbols, and abbreviations; the third, with forms; and the fourth gives miscellaneous useful tables. Parts I and III are intended for those directing a drafting-room as well as for draftsmen, while Parts II and IV would be of more direct value to the draftsmen themselves.

Hendricks' Commercial Register of the United States. 2381 pages, 8 by 10 inches. Published by S. E. Hendricks Co., Inc., 2 W. 13th St., New York City. Price, $10.

This is the twenty-seventh annual edition of Hendricks' Commercial Register for buyers and sellers, which is especially devoted to the interests of the electrical, engineering, hardware, iron, mechanical, mill, mining, quarrying, chemical, railroad, steel, architectural, contracting, and kindred industries, and furnishes a complete and reliable guide to the purchasers, manufacturers, and dealers connected with these industries. The products are listed from the raw materials to the finished article. The information contained in the directory has been compiled from data supplied by the concerns listed, obtained either by personal calls by representatives, or in response to requests for such information. The register is divided into three main sections. The first section is entitled "Classified Trades Section" and gives manufacturers of various products, by the products arranged alphabetically. A second section is included in which trade names, brands, etc., are alphabetically arranged, together with the name and address of the firm manufacturing the product known by the given trade name. The third section gives the names and addresses of the manufacturing companies alphabetically arranged. In addition, there is a complete index of the products, machinery, devices, etc., listed in the directory. The work is very valuable as a buyer's reference both in the machine building and in allied engineering trades.

Thomas' Register of American Manufacturers. 4200 pages, 10 by 12 inches. Published by Thomas Publishing Co., 129 Lafayette St., New York City. Price, $15.

Thomas' Register is a purchasing guide that aims to list all American manufacturers and primary sources of supply, and is the largest classified reference work of its kind. It is divided into five specific sections, of which the first contains a finding list and index of the various classes of machines, devices, products, and materials listed. The second contains the names and addresses of manufacturers classified according to their business. The third contains an alphabetical list of manufacturers in the United States, giving home offices, branches, and names of officers. The fourth is an alphabetical list of trade names and brands, giving the names and addresses of the manufacturers. The fifth contains a list of prominent manufacturers' representatives. There are also appendices giving representative banks, boards of trade and other commercial organizations, and leading trade journals. Questions such as the following are readily answered by the use of the Register: Where is the Bristol Co. located? Who makes Manx belting? Who succeeded the G. H. Bushnell Press Co.? How can a complete list of names of manufacturers of electrical goods be obtained? Buyers in all industries will find this work very useful in answering the many questions that come up in their daily work, and in locating the sources of supply for the products which they have to buy. It is equally useful to the sales manager in obtaining the names and addresses of possible customers.

Applied Mechanics, Volume II—Strength of Materials. By Charles E. Fuller and William A. Johnston. 566 pages, 6 by 9 inches. 282 illustrations. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $3.75.

This book is the second volume of a work on applied mechanics brought out by the authors who, as professors of theoretical and applied mechanics at the Massachusetts Institute of Technology, have prepared it primarily for the use of students in the departments of engineering at that institute. The second volume covers the strength of materials, and aims to give the fundamentals of this subject in as far as they may be required in subsequent work in structural and machine design and in the ordinary problems of engineering practice. The subject is handled in a manner especially intended for engineering students at advanced engineering colleges, and as a preparation the students should have a knowledge of differential and integral calculus, the principles of

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statics and dynamics, and the methods of determining centers of gravity and moments of inertia of areas of solids. The subject matter in the work is divided into fourteen chapters as follows: Physical Properties of Materials; Analysis of Stress and Strain; Uniform Stress and Uniformly Varying Stress; Stresses in Beams; Deflection of Beams; Continuous Beams; Combined Stresses; General Theory of Flexure; Columns; Shafting and Springs; Curved Bars; Arches and Catenaries; Cylinders and Plates; Reinforced Concrete Beams and Columns. The work may be recommended as a thorough text-book on the strength of materials for those who have the necessary mathematical foundation to be able to benefit by the treatment given, and who want to study the subject in a complete manner.

NEW CATALOGUES AND CIRCULARS

Rodney Hunt Machine Co., Orange, Mass. Circular advertising spur gear gate hoists for waterpower and canal service.

Independent Pneumatic Tool Co., Chicago, Ill. Circular describing the company's line of portable electric drills and grinders.

Walter A. Zelnicker Supply Co., St. Louis, Mo. Bulletin 259 containing a list of new and used tanks of all kinds and sizes.

Union Tool Chest Co., 10 Railroad St., Rochester, N. Y. Circular advertising Union tool chests, made in several sizes and styles.

Philadelphia Belting Co., 6th and Spring Garden Sts., Philadelphia, Pa. Bulletin containing price list and dimensions of "superpacking" leather.

Metalwood Mfg. Co., Detroit, Mich. Circular illustrating and describing the Metalwood 35-ton vertical broaching and general-purpose hydraulic press.

Electric Controller & Mfg. Co., Cleveland, Ohio. Circular advertising a push-button operated automatic compensator for use in starting electric motors.

Economy Drawing Table & Mfg. Co., Adrian, Mich. Catalogue N, giving dimensions and specifications for Economy drawing tables and sectional filing cases.

Gisholt Machine Co., Madison, Wis. Circular showing how the work of computing labor costs can be quickly and accurately accomplished by the use of the "Periodograph."

Detroit Stamping Co., 951 W. Fort St., Detroit, Mich. Circular giving dimensions of combination, gang, and round dies for flat and concentric washers, and spacers for milling machine arbors.

Barnes Drill Co., 814 Chestnut St., Rockford, Ill. Loose-leaf catalogue of Barnes self-oiling, all-geared drilling and tapping machines, sliding-head drilling machines, gang drilling machines, and extension gap lathes.

Unifiex Coupling Co., 246 Chestnut St., Philadelphia, Pa. Circular descriptive of the "Unifiex" coupling, which is of simple and strong construction and is adapted for any service where a direct connection is required.

Sidney Power Press Co., Sidney, Ohio. Catalogue covering the Sidney line of open-back inclinable presses, which range in capacity from 5 to 25 tons. Complete specifications are given for the five sizes of presses made.

American Petroleum Products Co., Williamson Bldg., Cleveland, Ohio. Booklet entitled "Use of Oil As a Fuel," containing considerable information relating to fuel economy, storage and feeding systems, and types of burners.

E. W. Bemis Machine Co., Worcester, Mass. Leaflet illustrating and describing the Bemis collet lathe chuck, made in two styles and sizes to be fitted either by threads to the nose of the spindle or by a flange to the faceplate.

Smith-Serrell Co., Inc., 144 Cedar St., New York City, manufacturer of "Francke" flexible couplings, is issuing a chart called the "Selectometer," for finding the correct size of "Francke" flexible coupling for any given drive.

CoKal Stoker Co., 48 W. Division St., Chicago, Ill. Circular descriptive of the "CoKal" stoker, which is claimed to effect unusual economies in fuel consumption due to the fact that the coking method of burning coal is employed.

Shevlin Engineering Co., Inc., 110 W. 34th St., New York City, manufacturer of boiler plant equipment, is distributing a celluloid card on which is given standard air spaces for grates. On the back of the card is a calendar for the year 1919.

Liberty Machine Tool Co., Hamilton, Ohio. Catalogue illustrating and describing the company's line of constant- and variable-speed planers. These machines have a number of improved features, and especial attention is called to the patented feed.

Crescent Belt Fastener Co., 881 Fourth Ave., New York City. Circular entitled "Why People Buy Crescent Belt Fasteners," illustrating and describing the principle upon which the Crescent belt fastener is made and showing how a Crescent belt joint is produced.

Baldwin Chain & Mfg. Co., Worcester, Mass. Bulletin containing information relating to the transmission of power by chains. Sizes of Baldwin block and roller chains are listed, and tables are included giving sprocket dimensions for various pitches and diameters of rollers.

W. J. Baird Machinery Co., 265 Jefferson Ave., Detroit, Mich., is publishing a house organ entitled "Baird Detroit," containing material of general interest, as well as articles giving information relating to the plant, organization, and personnel of the company and the machine tools which it handles.

Milwaukee Electric Crane & Mfg. Co., Inc., Milwaukee, Wis. Bulletin of Milwaukee electric traveling cranes, containing views showing installations of these cranes in various shops as well as illustrations of the different types of cranes and their details. The booklet outlines a number of improvements that have been made in crane construction.

Brown Hoisting Machinery Co., Cleveland, Ohio. Catalogue K 1919 of "Brownhoist" locomotive cranes. The catalogue contains many illustrations showing the standard types of these cranes in use in railroad, shipbuilding, steel, coal, lumber, foundry and manufacturing industries, and describes the cranes in detail, giving the capacities and other essential information.

Service Engineering Co., 25 Church St., New York City. Circular describing the personnel of the company and the work it is engaged in, which includes planning, estimating and consulting; developing inventions; designing machine tools; designing tools, dies, and gages; building tools and special machinery; and designing special and automatic machinery.

Webster & Perks Tool Co., Springfield, Ohio. Catalogue illustrating Webster & Perks pointing, thread-cutting, and special tapping machinery, and "Namco" automatic die-heads. These machines have a capacity for commercial threading and tapping operations on both regular and special work from 5/32 to 1¼ inch U. S. standard threads and for considerably larger diameters of finer pitches.

Saphil Mfg. Corporation, 147 W. Austin Ave., Chicago, Ill. Circular describing the Saphil portable electric tool, cutter, and surface grinder, showing illustrations of this grinding attachment engaged on internal, surface, and cutter grinding. The attachment can be applied to any lathe, shaper, or milling machine and can also be used as a portable tool. The circular also illustrates and describes Saphil boring tool attachments.

Ajax Metal Co., Philadelphia, Pa. "A Text-book on Babbitt Metals," giving information on selecting the proper babbitt metal for bearings and the correct method of babbitting. The various types of bearing metals made by the company are listed, and information is given concerning the particular use for which they are intended. "A Text-book on Ajax Ingots," describing Ajax methods of alloying metals and making ingots.

Universal Boring Machine Co., Hudson, Mass. Catalogue of Universal horizontal boring machines, containing fifty illustrations showing these machines at work drilling, milling, boring, counterboring, reaming, and facing in various shops throughout the country. Illustrations are also included showing the horizontal boring machines in the plant of the company engaged in making horizontal boring machines. Complete specifications for the machines are given, and the various details are illustrated by means of halftone and line engravings.

Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill. Loose-leaf catalogue containing a collection of bulletins covering the complete line of disk and ring wheel grinders made by this company, as well as the various accessories used in connection with these machines. The bulletins give the dimensions and specifications for the various sizes, as well as the equipment provided with each machine. Besides the disk and ring wheel grinders, the catalogue also shows pattern-makers' grinders equipped with roll sanding attachments. The Besly ring-oiling spindle construction is illustrated and described in detail.

New Britain Machine Co., New Britain, Conn. Catalogue, printed in colors, illustrating and describing the New Britain six-spindle automatic screw machine. Following a comprehensive description of this machine, its parts and attachments, are line illustrations showing, step by step, the operations performed on nineteen different classes of work, the part being shown as it appears after each operation; the material and production time are given in each case. The book concludes with tables giving dimensions for tooling, floor and setting-up plan, specifications for the three sizes of machines—1- by 5-inch, 1⅝- by 7-inch, and 2½- by 9½-inch—and production tables.

Graton & Knight Mfg. Co., Worcester, Mass., oak leather tanner and belt maker, has recently published Catalogue 7, printed in two colors, showing the different processes of belt-making, from the time that the hide is received until the finished belt is produced. The catalogue illustrates and describes the different products made by the company. The belting section fully explains the characteristic qualities and the capabilities of the different brands of belting. It also embodies mechanical rules, tables, and other information which should be of value in determining the most efficient belt for any drive or in assisting with other transmission problems. A copy of the catalogue will be sent to anyone interested.

Air Reduction Sales Co., 120 Broadway, New York City, is distributing a booklet entitled "A Short Course in Oxy-acetylene Welding," by Alfred S. Kinsey, professor of shop practice, Stevens Institute of Technology, and organizer and director of a special war course in oxy-acetylene welding and cutting at the 23rd St., Y. M. C. A., New York City. It is intended that the course shall cover twelve three-hour periods. Of this time about one-third should be devoted to lectures and the remainder to the operation of the torches. The booklet lays out the work to be covered in each period, stating the object, the lecture, and the practical work. Opposite the outline of work are blank pages for notes.

Charles A. Schieren Co., 30-38 Ferry St., New York City. Price list of Schieren beltings, describing the various brands, grades, and weights, which are designated by different names, so that it is possible to specify by the name exactly the type of belting required. The booklet also gives prices of cut lacing and includes directions for cutting up a side of lace leather. Booklet entitled "The Story of Schieren Beltings," describing the manufacture of leather belting, step by step, under the following heads: Selection of Hides; Peeling and Storing Oak Bark; Grinding and Leaching Tan Bark; Preparing Hides for Tanning; Tanning Vats; Cutting Up Belting Butts; Shaving and Scouring; Stuffing with Animal Grease; Stretching the Hides; Drying; Lapping and Cementing; and the Finished Product.

TRADE NOTES

Frank G. Payson Co., 9 S. Clinton St., Chicago, Ill., has recently been organized by Frank G. Payson, formerly president of the Neidow & Payson Co., and has been appointed general selling agent for the Logansport Machine Co., manufacturer of the Logan air-operated chucks.

Advance Tool Co., Canal and Jackson Sts., Cincinnati, Ohio, manufacturer of reamers, milling cutters, and small tools, has made arrangements with the J. R. Stone Tool & Supply Co., Detroit, Mich., to represent the company in the state of Michigan. A full line of Advance tools will be carried in Detroit.

Horne Co., Ltd., Tokio, Japan, a Japanese corporation which was formed by F. W. Horne to succeed the old established business of F. W. Horne & Co., has been purchased from Mr. Horne by the American International Corporation, which will continue the business of F. W. Horne & Co. along its present lines under the new name of Horne Co., Ltd.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., announces that the eastern branch of the company, located in New York City, will be moved on March 1, from 170 Broadway into larger quarters at 1463 Broadway near 42nd St. This change was made necessary on account of the company's increased business in the eastern territory.

Biggs-Watterson Co. of Cleveland, Dayton, and Detroit have taken over the entire plant of the Dayton Metal Products Co., Dayton, Ohio, and have placed this company's large stock of machine tools and supplies on the market. The equipment comprises screw machines, turret lathes, thread milling machines, etc., as well as a large stock of cutters, drills, reamers, and other small tools.

C. H. Westerberg, 9-11 West Broadway, New York City, specialist in metal-cutting tools, has recently been incorporated under the name of C. H. Westerberg & Co., Inc., with the following officers: C. H. Westerberg, president; A. M. Maddox, vice-president; Charles Westerberg, treasurer; E. Goehrig, secretary. The management, personnel, and finances will remain the same as heretofore.

Fitchburg Automatic Machine Works, Fitchburg, Mass., makers of the "Radical" four-spindle automatic screw machine, have been purchased by the P. W. V. Automatic Machine Corporation, and will henceforth be known by that name. The new company will continue to build the "Radical" automatic screw machines. The officers of the new corporation are F. D. Van Norman, president; L. M. Waite, vice-president; C. J. Wetsel, treasurer.

Cling-Surface Co., Buffalo, N. Y., has made a special study of belt slip and its attendant costs, and has issued a small, handy chart, together with a "Cling-Surface" formula for accurately figuring the cost of belt slip. The chart shows, for example, that if the total cost of fuel in the power plant is $10,000, a 5 per cent total slip, including creep, which is a very low assumption, costs $300 a year, which can be saved by stopping the slippage of the belt.

Logansport Machine Co., Logansport, Ind., has developed a line of air-operated chucks to be known as the "Logan" chucks, which contain many new features. This company, which in the past manufactured special machinery, including air-operated devices, will devote its factory entirely to the production of "Logan" air chucks. George F. Hopkins, formerly superintendent of the Frost Gear & Forge Co., Jackson, Mich., has been appointed works manager, and the Frank G. Payson Co., 9 S. Clinton St., Chicago, Ill., has been granted the exclusive selling rights for the United States and foreign countries.